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BRIEFLY TOLD.

NOT THE SECRETARY'S FAULT.—The members of our Associations do not, as a rule, thoroughly appreciate the great amount of routine work that comes with the honors connected with officeholding in such organizations, and this remark applies, of course, with greater force to the Secretary's office and its duties, than to any other of the executive positions. When the meeting time is on the members note in the aggregate that everything is working smoothly and their satisfaction increases with the continued absence or non-development of "hitches" of any sort. That "hitches" fail of development is evidence that the executive management was on the alert months before the time of meeting, planning and preparing for the days to come, with their opportunity for either concordance or incongruity. The obtaining of the former means work—unobtrusive and unproclaimed, but nevertheless "work" at once arduous and continuous. All of which leads up to the further remark that when, in the course of things, illness or absence causes a break in the regularity, with which interim official action has been performed, the member whose communication to the President or Secretary, or member of some of the standing committees, is not promptly answered, is apt to feel that perhaps the officers are neglectful.

It is so generally accepted that Secretary Humphreys, of the American Association, is a model of precision in respect to business ways, that any departure therefrom is, to say the least, strange. Several communications recently addressed to him regarding the business of the American Association have been unanswered for some days, and we heartily wish that we could trace the delay to neglect, pure and simple, on his part, for then we would not be obliged to explain that he has been ill for some time—so ill, in fact, that for over a fortnight he has been unable to leave his room. He is on the mend, however, and by the time this explanation is before our readers, it is quite certain that the Secretary will be about, as spry and as attentive as ever.

MR. EGNER'S GOOD BYE TO ST. LOUIS.—The men who served under Mr. Egner, when that gentleman acted as Chief-Engineer to the consolidated gas companies of St. Louis, evidently do not agree with their masters, the proprietors of the companies, in the latter's estimate of his abilities. And we are led to this view by extracting a result from the cube of their respective ways of "equating" their beliefs. In the first place, the Company, in order to "reduce expenses," asked Mr. Egner to "resign" his position, and to manage the resignation with an expedition equal to turning his papers, accounts, and so on over to his successor *in exactly four days*. Please to bear in mind that the original decree gave Mr. Egner precisely 96 hours in which to shut up shop, so to speak. The energetic campaigners of the fortunes of St. Louis gas interests subsequently added 30 days of grace to the original—four-day note-at-sight, might we call it? So much for the masters; and now for the men. Mr. Egner, it seems, did not care much about the respite: and it would be passing strange if he did. Possibly he reasoned as did the Kentuckian who, having been sentenced to death, was told by the sheriff that if it would be any comfort to him his body would not be interred for the period of ten days after the sentence had been carried into effect, replied, "The subsequent proceedings will not interest me, I fear." No matter, however, for his reasoning. He did not accept the respite, but,

feeling that he was dead to St. Louis, at once set about securing a resuscitation at some other point. Hence we are likely to have him in New York, as Engineer to the Standard Gas Company of this city. But we are a trifle ahead of our story.

Mr. Egner, after some days spent in the East, returned to St. Louis, on the evening of the 24th inst., there to find a summons awaiting him to pay a visit to the Laclede Company's headquarters. Wondering not a little at such a request, he nevertheless complied and his wonderment increased at finding himself confronted by a delegation representing every branch of the Company's service—division engineers, clerks, foremen, stokers, and even a laborer or two—the President of the Company was not there, however. To make a long story short, the men were there to present to Mr. Egner a diamond, as an earnest of the sparkle there was in their regard for their retiring chief. The really magnificent gem was accompanied by a beautifully worded testimonial, giving expression to the donors' appreciation of the career of Mr. Egner amongst them as a director, counsellor and friend. Messrs. Chollar, Carroll, Callahan, Williams and Galloway made speeches, the tenor of which caused Egner to "flunk" so completely that he could scarcely say a word in return—in fact, he had more use for a handkerchief than anything else. Now, who are in the right, the men or the masters?

Blanks for Gas Companies' Accounts.—In our last issue we gave, in our concluding instalment of the official report of the last meeting of the Western Gas Association, the discussion that was had over the blank forms (with a copy of the latter) recommended by the committee appointed to secure uniformity in accounts of gas companies. In the course of the discussion Mr. Slater, of Providence, submitted a copy of the forms in use by the Providence Gas Light Company, and a still further form (that employed by the Sedalia Gas Light Company, of Sedalia, Mo.) was put in evidence by Mr. E. H. Jenkins, of Columbus, Ga. Owing to the pressure on our space in last issue we were unable to reproduce the Slater and Jenkins forms, but the same will be found, complete, on pages 928-9 of this number of the Journal.

A Safe and Pleasant Journey to Them.—Mr. Thos. Turner, the President-Engineer of the Charleston (S. C.) Gas Light Company, accompanied by his wife and daughter, sailed for Europe, last Saturday, from New York city, per steamship Umbria. The party will return in October.

The New Plant at Morristown, N. J.—The proprietors of the Morristown (N. J.) Gas Company have awarded a contract for the erection at that point of a complete 10-inch coal gas works, to Messrs. Bartlett, Hayward & Co. The work is to be completed by December next. A new site has been purchased, which will enable the Company to work at a great advantage over the old location in the matter of handling supplies, etc. The holder station will be the same as now, the Company having ample storage capacity.

Notes.—Mr. William S. Somerville, son of Mr. James Somerville, of Indianapolis, Ind., has been appointed Superintendent of the Gas and Electric Light Company, of Springfield, Mo. He entered upon his duties on the 1st inst.——The proprietors of the Santa Ana (Cal.) Gas Company have purchased the local electric lighting plant established by the Messrs. Parker, Parker and Harris, and will hereafter operate the same.——Giovani Girandi has brought suit against the San Jose Electric Improvement Company for damages in the sum of $11,000, on account of injuries alleged to have been received from contact with an imperfectly insulated lighting wire, maintained by defendent.

The Use of Gas for Ventilation.

In an article communicated to the London *Journal*, Mr. Thos. Fletcher, F. C. S., remarks that, as in many other applications of coal gas as a fuel, its use for the purpose of ventilation has been, up to the present, without any system or knowledge of the proper conditions necessary; and I have for this reason undertaken a series of experiments with the object of determining the laws which rule its application. An examination of the table given below will show some curious and unexpected facts.

It is, of course, well known that for ventilation, or for heating a body of air, the available duty of a luminous or an atmospheric burner is precisely the same; and the choice is purely a matter of convenience and suitability for the conditions necessary. First of all we must consider the fact that burners for this purpose are generally placed in a position where they are difficult or inconvenient to get at and examine; and they are liable to be left for years without any attention. They are also subjected to strong vertical currents; and, when not required, must be capable of being turned down, with a bye-pass, to a small pilot light, to prevent the necessity of relighting. All these conditions point to the desirability of using small ordinary union jets; and the table shows that the quantity of gas required for any ventilating shaft is remarkably small. When this quantity is exceeded, the duty obtained from the excess is so little that, under ordinary circumstances, the extra gas may be considered almost as wasted.

There is one source of error in the experiments, which I have found it impossible to entirely eliminate—the fact that I have been unable to obtain a portable and convenient meter which accurately indicates fractions of cubic feet; and the attempt to correct this by long runs, has made the experiments most tedious, lasting over a long period. The meter used registered, on an average, 1 per cent. fast; but all the other instruments were absolutely correct. The anemometer was verified, and the correction tables were used; the chronograph was perfect; and the thermometer was recently verified for the purpose. To prevent any doubt as to the choice of burners, the experiments were repeated under exact conditions alternately with a gauze atmospheric burner, and with a flat-flame—both burners being used under pressures varying from $\frac{3}{10}$ to $1\frac{1}{8}$; and the results with each form of burner, under all pressures, were absolutely identical.

Vertical Flue, 6 Inches Diameter, 12 Feet High.

Gas burnt per Hour. Cubic Feet.	Speed of Current per Minute. Feet.	Total Air exhausted per Hour. Cubic Feet.	Air Exhausted per Cubic Foot of Gas burnt. Cubic Feet.	Temperature at Outlet. Normal 62° F.
1	205	2,460	2,460	82°
2	245	2,940	1,470	92°
4	325	3,900	975	110°
8	415	4,980	622	137°

With precisely the same arrangements, but with the flue cut down to 6 feet in height, the available duty was reduced 20 per cent.

Taking the experiments as a whole, it will be seen that, in a flue 6 inches in diameter, the maximum speed of current which can be obtained with economy is about 200 feet per minute; and this was realized with a gas consumption of 1 cubic foot per hour—1 cubic foot of gas removing 2,460 cubic feet of air. To double the speed of the current, it was necessary to burn 8 feet of gas per hour—eight times the quantity; and the effective duty per cubic foot of gas burnt dropped to one-fourth.

It is a very common thing to see a ventilating shaft, 6 inches or less in diameter, with burners under it consuming from 15 to 20 cubic feet of gas per hour; and it is quite evident that the greater part of this is completely wasted—in fact, in many cases it is worse than wasted, as the extra heat evolved is often very objectionable when radiated from the flames and the external surface of the shaft. The heat escaping at the top of the flue varied from the equivalent of 49,200 cubic feet heated 1° F. to 373,500 cubic feet heated to the same extent; the amount of heat escaping increasing in regular proportion to the increase in the gas consumption.

These experiments establish the following important facts: That the maximum consumption of gas in a ventilating flue should not exceed 5 cubic feet per hour for each circular foot area of section; that the effective duty of atmospheric and illuminating flames is the same in all cases where a large quantity of air has to be heated to a low temperature; and that the consumption of 1 cubic foot of gas in a ventilating shaft can be made to remove more than 2,400 times its own bulk.

The advocates of the so called "destructors" for sewer ventilation carefully avoid any positive statements and figures, and we are led to believe that a consumption of gas equal to 8 cubic feet per hour will heat 250 cubic feet of air per minute, or 15,000 cubic feet per hour, to temperatures varying, according to the imagination of the observer, from 400° to 600° F. As a matter of fact, such a result is a total impossibility; and the heating of a limited surface to 400° or 600° F. by no means ensures either the heating of the surrounding air to anything approaching this, nor does it ensure the destruction of all the germs contained in the air. The experiments detailed above show clearly that, with a large bulk of air and a small gas consumption, high temperatures are impossible; and the mistake has arisen from jumping at the conclusion that, if air is passed through an apparatus heated to 400°, all the air must be heated to this temperature, which is by no means a necessary consequence. It would be desirable that the "destructors" should be tested by an analysis of the air before and after passing; as, judging by the foregoing experiments, it would appear that the average rise in temperature in the "destructor" shafts would be only 25° F., provided that the specified quantity of air is passed.

Purification.

[A Paper read before the Incorporated Institution of Gas Engineers, by Mr. Charles Hunt of Birmingham.]

Since the paper which was read by Mr. Frank Livesey at the Sheffield meeting of The Gas Institute in 1883, attention has been more than once directed to new and promising processes of purification. Much has been done to widen out the subject of purification; and it is therefore possible that something in the nature of a survey of it, however imperfect, may not at the present time appear inopportune.

It is worthy of remark, at the outset, that the London Companies appear to have entirely outgrown the aversion with which at one time they viewed the requirements of the Gas Referees as to the reduction of sulphur compounds. At this distance of time, it is not easy to understand why, apart from any question of such reduction, the advantage of lime as a comparatively cheap means of improving the illuminating power of gas by the removal of the carbonic acid should have been so generally disregarded. By compelling such removal, the restrictions that were so much objected to must have resulted in greater benefit to the Companies, in the shape of increased luminosity of the gas, than could be represented by the additional cost of purification.

Carbonic acid is known to be the most harmful to the illuminating power of all the incombustible diluents usually present in purified coal gas. Nearly forty years ago, Alexander Wright, following in the footsteps of Lewis Thompson, published in the *Journal of Gas Lighting* a series of experiments showing the depreciating effect of a mixture of this gas with cannel gas to be from 6 to 11 per cent. for every 1 per cent. of carbonic acid present. He pointed out, however, that by using burners more suitable for the combustion of the inferior gas, the loss might be reduced to from 3 to 7 per cent., according to the description of burner employed. In 1884, Professor Percy F. Frankland presented a paper to the Chemical Society on "The Influence of Incombustible Diluents on the Illuminating Power of Ethylene," which showed that the effect of a mixture of 6.32 per cent. of carbonic acid was to lower the illuminating power of the ethylene 3 per cent. for every 1 per cent. of carbonic acid. Mr. J. T. Sheard published in 1887 some experiments showing that cannel gas, tested with an Argand burner, loses about 3 per cent. of luminosity for every 1 per cent. of carbonic acid present in the gas.

Just twenty years ago the author, who was then at the Nine Elms Gas Works, made a number of experiments upon this subject, some of which it may be useful to quote. The gas used varied in quality from a little more than 12 to about 30 candles, and was made with mixtures of coal and cannel, so as to vary the percentages of carbonic acid. On its way to the photometer, the gas was passed through two experimental meters, between which was placed a small dry lime purifier. Attached to the purifier was a bye-pass, and the gas was made to flow alternately through the bye-pass and the purifier. The index of each meter being taken at the beginning and end of each experiment, the difference in registration was arrived at, and also the difference arising from the absorption of carbonic acid by the lime. The following are the results arrived at with common gas, tested by the then Parliamentary Argand:

CO_2 in Gas, per Cent.	Illuminating Power per 5 Cubic Feet Consumption.		Increase of Illuminating Power.		Increase per Cent. for every 1 per cent. CO_2 removed.
	With CO_2.	Without CO_2.	Candles.	Per Cent.	
7.6	14.04	17.34	3.30	23.5	3.1
5.2	14.08	16.04	1.96	13.9	2.7
3.8	14.62	16.23	1.61	11.0	2.9
6.5	11.17	13.75	2.58	23.1	3.5
2.7	12.21	13.16	0.95	7.8	2.9

Average increase per cent. for every 1 per cent. of CO_2 removed, 3.

The following are particulars of an experiment made recently under the direction of the author:

	Candles.	Percentage of CO_2.	Height of Flame in Chimney.
			Inches.
Illuminating power of gas per 5 cubic feet consumption, tested with a No. 1 standard Argand burner, 6 in. by 2 in. chimney, and Methven's screen.....	16.6	1.36	3¼
Do., after passing through experimental lime purifier.....	17.2	0.04	3½

These figures show for 1 per cent. of carbonic acid a loss of luminosity of 2.6 per cent.; or, on the basis of a normal production of 10,000 cubic feet per ton, a reduction of 1.67 per cent. in value for 1 per cent. of carbonic acid. Thus:

$10{,}000 \times 17.2$ candles.....	= 172,000
$10{,}000 + 1.32$ per cent. $CO_2 \times 16.6$.....	= 168,191
Difference.....	3,809

or 2.2 per cent., which, divided by 1.32, equals 1.67 per cent. for 1 per cent. of carbonic acid. For small percentages of carbonic acid, this figure is probably the lowest on record. It indicates, however, an adverse effect of nearly, if not quite half a candle, upon common gas, from the presence of from 1½ to 2 per cent. of carbonic acid.

The cost of enriching gas to the extent of 1 candle only by means of cannel has recently been stated by Mr. Frank Livesey to be 2.68d. per 1,000 cubic feet made. Field's "Analysis" for 1889 gives the average cost of purification to the three London Companies as 0.76d. per 1,000 cubic feet sold.

No system of purification can fully satisfy the economic instinct which does not provide for the elimination, in a saleable form, of such impurities as possess a market value. Economy may, however, be justifiably assigned a second place by the attainment of greater security and efficiency. The first object is to effect purification, by which is meant compliance with the London standard; and the next, to do the work as cheaply as possible.

In this view, the two chief methods of dry purification in present use appear to be in competition for survival. One of these may be described as that in which a different material is employed for each impurity, generally, though not always, in separate vessels; the other, in which lime is either the sole material or else supplemented, as a measure of precaution, by oxide of iron or other suitable material in check or catch purifiers.

With the first method, seldom fewer than eight, sometimes as many as ten, purifiers are used. The impurities being attacked separately, the cost of removing each of them may be accurately ascertained; and the only one of present value—sulphur—becomes a salable product. As a set-off to these advantages must be considered a somewhat large capital outlay, with corresponding occupation of ground space, and an apparent complication of arrangements, requiring great watchfulness to prevent irregularity in the reduction of sulphur compounds. Moreover, at the present time, the production of spent oxide is generally unremunerative.

The second, and by much the older method involves the use of only four purifiers—three at work and one off—although two catch-vessels are sometimes added. A somewhat greater area per purifier would seem, however, to be needed than in the first method, because the whole of the impurities are dealt with in the same vessel.

Lime being the sole material used, the quantity required must, under ordinary conditions, correspond not only with the carbonic acid to be removed, but with the sulphureted hydrogen in addition. It would seem, therefore, that the all lime method cannot possibly compare favorably, in the matter of economy, with the lime and oxide; while the continual displacement of sulphureted hydrogen from its combination with the lime by the carbonic acid as it advances, causes the removal of the sulphur compounds to be somewhat uncertain. This objection is to be overcome by changing the purifiers according to the quantity of sulphur compounds coming forward; but only, as would seem, at the cost of additional lime. The liability to nuisance from the foul lime is also an objection to this method. If, however, a little air or pure oxygen be added to the gas, these difficulties are found to largely, if not wholly disappear. A certain amount of free sulphur is deposited in the lime, and a portion is oxidized as sulphites. The chemical reactions which occur appear to be imperfectly understood. The spent lime is, however, rendered practically inodorous; and, owing perhaps in some measure to the greater heat evolved by the increased chemical action within the purifiers, the sulphur compounds are reduced with constancy and regularity.

Air used with oxide of iron is a very old expedient; and it should be reassuring to the popular sentiment with regard to it to know, upon the authority of Professor Frankland, that it is the least prejudicial to the illuminating power of all the diluents which are incidental to the manufacture of coal gas; its effect being almost proportional to the quantity present. Practically, therefore, no depreciation of value results from the mixture. This not unfavorable influence is probably due in some measure to the oxygen contained by the air; a mixture of oxygen having been found, especially in the case of a very rich gas, to assist luminous development. In the purifiers, however, the oxygen is either wholly or partially withdrawn; and hence, when applied in the form of atmospheric air, it is the effect of the nitrogen that remains which has to be reckoned with.

The experiments made by Professor Frankland, already referred to,

showed that mixtures of nitrogen with ethylene varying from about 15 to 71 per cent., reduced the illuminating power of the ethylene from 1.57 to 1.25 per cent. for every 1 per cent. of nitrogen added; the least proportionate depreciation taking place with the highest percentage of nitrogen. Taking into account, however, the increase of volume from the added nitrogen, the actual depreciation of value is considerably less than would be indicated by these figures. Thus, while with 15.36 per cent. of nitrogen added, the loss of luminosity is shown to be 1.57 per cent. for every 1 per cent. of nitrogen, the actual depreciation of value works out at only 0.81 per cent. This means about 0.13 of a candle for common or 16-candle gas.

The following particulars of experiments upon a working scale with air and oxide of iron purification have been kindly placed at the disposal of the author. They bear evidence of having been conducted with the greatest care and accuracy.

	No.	Total Gas Made. Cubic Feet.	Gas Made per Ton. Cubic Feet.	Illuminating Power. Candles.	No. of Tests of Illuminating Power.	Percentage of Cannel Used.	Percentage of Air Admitted.	Value. Gas Made Per Ton x Illuminating Power.	Diminution in Value by Admission of Air. Multiple.	Diminution in Value by Admission of Air. Per Cent.	Diminution in Value Per Cent. by 1 Per Cent. of Air.
Same mixture of coal	1	850,000	10,923	22.19	75	50.0	..	242,381	..	..	..
	2	642,000	10,940	21.92	53	..	0.75	239,804	2,577	1.06	1.4
	3	657,000	11,239	21.42	47	..	1.61	240,739	1,642	0.67	0.4
	4	750,000	10,989	21.53	49	..	2.86	236,593	5,788	2.38	0.8
Do.	5A	283,000	10,884	22.97	16	57.7	..	250,005	..	..	..
	5B	294,000	11,308	22.01	..	..	3.44	248,889	1,116	0.44	0.1
Do.	6A	281,000	10,807	22.94	..	53.8	..	247,912	..	..	..
	6B	284,000	10,923	22.45	..	..	1.58	245,221	2,691	1.08	0.6
Do.	7A	284,000	10,923	23.60	..	60.0	..	257,783	..	..	..
	7B	295,000	11,345	22.26	..	..	4.86	252,540	5,243	2.03	0.4

Average diminution in value per cent. by 1 per cent. of air, 0.5.

The smaller amount of depreciation which is shown with the highest percentages of air may be partly accounted for by the presence of oxygen in the outlet gas. Oxygen is, for some reason, less active with oxide than with lime. Traces of it may be found at the outlet of oxide purifiers, at the same time that none can be detected at the outlet of lime purifiers, although entering both sets of purifiers in the same proportion.

Experiments made upon the lines of those which have just been quoted ought not to yield very discordant results; yet it has to be admitted that considerable diversity of opinion exists as to the proportion of air which may be mixed with the gas without appreciable loss of illuminating power. Some think that from 3 to 4 per cent. may be so employed; but the greater number draw the line at about 1 per cent. On the other hand, Mr. Valon has found that, with mixtures of 2½ per cent. and upwards, every 1 per cent. of air reduces the illuminating power by fully 7 or 8 per cent.

It would be a difficult task to seek to reconcile such very great differences; but it may be of some assistance to point out at least one probable source of error, either unsuspected or disregarded. This is in the accepted method of testing with what is known as the standard burner. It is many years since the author first drew attention in the *Journal of Gas Lighting*, to the variable results yielded by this and other burners with the same gas, at different rates of consumption. The subject afterwards engaged the attention of the then Gas Referees; but quite recently a pronouncement of considerable importance has been made by no less an authority than Mr. A. V. Harcourt, a present Gas Referee. While discussing Mr. Methven's paper on "Photometry," read last year before the Southern District Association of Gas Engineers and Managers, Mr. Harcourt said: "With the London Argand, if the consumption were reduced by one-fifth, the yield of light sank to about one-half; and, from the same causes, if the actual qualtity of the gas were somewhat low, the yield of light with a consumption limited to 5 cubic feet per hour was greatly reduced. Thus any deficiency in the gas was much exaggerated. A more just estimate would be found by setting the light of the burner equal to 16 candles, and observing the rate of consumption."

This puts the case in a nutshell. It is clear that startling results obtained by adhering to the prescribed rate of consumption can possess no claim to scientific accuracy, and are, indeed, likely to be greatly misleading, as the candle value becomes disturbed. A candle loss does not mean that of a real candle, except under conditions which are rarely met with outside the photometer room. It is doubtless true that the gas maker must stand or fall by his standard burner and prescribed rate of consumption; but he has at least the satisfaction of knowing that the practical measure of any loss indicated by the present unscientific method of testing is not the observed effect, but that which is required to compensate for it. Thus where, as mentioned by Mr. Harcourt, the light is diminished by about one-half from a reduction in the consumption of one-fifth, it requires, not double the consumption, but only one-fourth more, to produce the same amount of light as before. Similarly, the quantity of light-giving material required to restore to its original luminosity the adulterated gas experimented upon by Mr. Valon, should be, not Mr. Valon's 7 or 8 per cent. for every 1 per cent. of air, but rather Professor Frankland's 1 per cent., or, upon the basis of nitrogen depreciation, from 1¼ to 1½ per cent.

It cannot be correct to charge the gas with the imperfections of the burner. In all investigations of this kind, the rule should be to adjust the consumption to the point of economic combustion. The effect of this is seen in the following experiment, where the depreciation in luminosity proved to be only 1.4 per cent., as against 4.6 per cent. at the prescribed rate of consumption:

Description	Tests made with a Consumption of 5 Cubic Feet of Gas per Hour. Illuminating Power. Candles.	Loss of Illuminating Power. Candles.	Loss of Illuminating Power. Per Cent.	Tests made with Chimney full of Flame; the Illuminating Power calculated on a Consumption of 5 Cubic Feet of Gas per Hour. Illuminating Power. Candles.	Loss of Illuminating Power. Candles.	Loss of Illuminating Power. Per Cent.
Gas	50.70	..	..	16.33	..	..
Mixture of 90 per cent. of the gas and 1 per cent. of air	14.97	0.73	4.6	16.10	0.23	1.4

Illuminating Power of Gas Tested under Different Conditions.

Chimney. In.	In.		Consumption per Hour. Cubic Feet.	Illuminating Power calculated on a Consumption of 5 Cubic Feet of Gas. Candles.
7	2		5.00	13.72
6	2		5.00	15.75
6	1¾		5.00	16.08
7	2	full of	6.95	16.91
6	2	flame	6.10	16.97
6	1¾		5.73	17.04

With a consumption of 5.02 cubic feet per hour (standard temperature and pressure), the gas tested 16 candles in a 6-in. by 2-in. chimney; therefore 15.93 candles for 5 cubic feet per hour.

The foregoing experiment also shows what is, in most cases, the point of economic combustion, and at the same time how greatly, with the same gas, the results may be made to vary with the same burner.

The best effect in this instance, was obtained when the flame fairly filled the chimney, without smoking or tailing over; and in this condition the gas showed little variation with any of the three chimneys. Occasionally, however, a gas may be met with which yields a better result with a shorter flame than this.

Pure oxygen, as a substitute for air, has found an able advocate in Mr. Valon; and there must be a common agreement of opinion as to its superiority, owing to the absence of nitrogen. On this account alone, it is entitled to rank high as a purifying agent, because it enables economy of material to be pushed to the utmost limit without injury to the gas. In conjunction with lime, it is said, the quantity of the latter for complete purification of the gas may be reduced to almost that which is required for the removal of the carbonic acid alone. This should result in the further advantage of a corresponding reduction of purifying area. In other respects, however, those who have had experience with air can hardly fail to recognize in its effect an almost perfect similarity to that of oxygen. There is the same chemical activity, as indicated by the temperature of the purifiers; the same saving of lime in proportion to

the oxygen employed; the same absence of odor in the foul lime; and last (though not least) the same, or practically the same, reduction of sulphur compounds.

The depreciating effect of nitrogen has already been mentioned as amounting, in the case of 16-candle gas, to about 0.25 of a candle for every 1 per cent. of dilution—representing about 0.13 of a candle loss in value; and this is the amount of the bill which, in some way or other, has to be paid when air is used. It is conceivable that so small a loss may, under some circumstances, be unperceived, and when otherwise it should not be difficult to compensate for it by a slight alteration in the method of working. When, also, the air and lime process is substituted for one in which the carbonic acid is only imperfectly extracted, the loss resulting from the added nitrogen may be fully or more than made up by the gain derived from the complete removal of the carbonic acid, the depreciating effect of which is nearly double that of nitrogen, and fully two and a half times that of air. Except under restrictions as to the removal of sulphur compounds, it is rarely that carbonic acid is reduced below 0.50 or 0.75 per cent., the removal of which would quite compensate for the addition of from 1 to 1.5 per cent. of nitrogen.

For complete purification, however, and bearing in mind that the less air the more lime, omitting also the lime required for the removal of carbonic acid, which is common to all methods, the comparison as to cost is either between oxide of iron and calcium sulphide (or sulphydrate) purification, or lime sufficient to remove both the sulphureted hydrogen and the sulphur compounds, on the one hand, and oxygen (with credit for reduction of purifying area) on the other; or between the latter and any means by which the loss of luminosity caused by the dilution with nitrogen from the air may be made up, credit being taken for the metered nitrogen.

The quantity of material required for purification necessarily varies with the amount of impurities to be removed. On a basis of 70 per cent. of caustic lime being used up, the theoretical quantity required to remove an average of 2 per cent. by volume of carbonic acid, or 1629 grains per 100 cubic feet, would be 2.96 cubic yards per million cubic feet of gas purified. For the removal of 1.25 per cent. by volume of sulphureted hydrogen, or 786 grains per 100 cubic feet, on the supposition that the ratio of sulphur to calcium in the spent lime is as 1 : 1.25, a further quantity of 1.83 cubic yards per million cubic feet of gas purified would be required; making 4.79 yards in all. Only the lesser of these two quantities can, of course, be affected by the use of oxide of iron, air, or pure oxygen.

Some difference of opinion exists as to what purifying area is necessary. It is generally found that a large area is conducive to economy of purifying material, as shown by the greater proportionate duration of the purifiers in the period of least production. This, however, may be owing in some measure to a smaller quantity of impurities. When, as in winter, a large proportion of stacked coal is used, the quantity of impurities may be greatly increased. In the author's experience, the percentage of carbonic acid alone has risen, apparently from this cause, to 2.6, from a normal 1.4 to 1.8.

In determining the area of purifiers, the chief points to consider are back pressure and the maximum quantity of impurities—viz., carbonic acid and sulphureted hydrogen—at the period of the greatest make. It is undesirable to work with a greater back pressure than (say) 20 inches in all, of which one-third to one-half may be represented by the purifiers, although not unfrequently this is greatly exceeded. With oxide of iron the resistance is much less than with lime, when it follows the former, and is used for taking out carbonic acid; the lime having a tendency to harden when carbonated. Sulphureted hydrogen, however, seems to keep the lime open; so that, with regard to back pressure, the all-lime process may be said to rank with oxide of iron.

If the maximum quantity of impurities and quality of material are ascertainable with any degree of accuracy, these should enable the duration of a purifier to be calculated with tolerable certainty; and, after all, the question of purifying area is to a great extent one of how long the purifiers will last during the period of greatest make. With oxide of iron, such a method of determining area is probably of little value, because of the varying efficiency of the material according to its quality and the quantity of sulphur it has taken up. The quality of lime is, however, practically unvarying from one period to another; and with it such a method should not present much difficulty if the ratio of sulphur to calcium in the spent lime be ascertainable.

As to what may be the most convenient interval to elapse between a change of purifiers, opinions will probably be found to differ almost as much as circumstances. So long, however, as a purifier is not too large to be emptied and re-charged without strain within the limits of an ordinary working day, a minimum interval between the charges of from two to two and a half days would appear to be sufficient. This is much greater than is often the case when oxide of iron is used.

If this view be correct, one effect of the use of air or oxygen should be a reduction of the area of each purifier, because the same amount of material is made to do more work. This point, however, in favor of these processes, has not yet been fully established; and it is not improbable that a reduction of area proportionate to the saving of material might, in many cases, result in forcing up the back pressure beyond the limits of convenience or safety.

The use of pure oxygen as a means for increasing the luminosity of coal gas does not properly belong to the subject of purification; but, having become somewhat prominently associated with the latter, a brief reference to it may not seem out of place. No apology should be needed for once again referring to the authoritative experiments of Professor Frankland, which show the greatest effect produced by oxygen as a diluent to be an increase in luminosity of the mixture, as compared with ethylene alone, of just 0.33 per cent., or an actual increase of value of 1.5 per cent. for every 1 per cent. of oxygen added. Contrasted with this infinitesimal result, the claim advanced on behalf of oxygen as an enricher would appear to be, and probably is, wholly untenable. More than one cause may be at work to deceive an observer; and the results showing increased luminosity due to oxygen may (in part at any rate) be attributable to the exaggeration of the standard burner. This is not confined to the "down grade" of consumption in quality, but extends upwards also, until the point of utmost economy is reached. It is as well also to bear in mind that oxygen is not an illuminant, but merely a supporter of combustion. As such, it can do little more than supplement the effort of the burner. Oxygen cannot be said to increase the intrinsic value of coal gas for either heating or lighting purposes, in the same way as is effected by adding hydrocarbons derived from cannel or oil.

So long as the recovery of sulphur from waste lime continues to be unremunerative, it would appear that, although, more costly for labor and purifying area, the oxide and lime must be the most economical system of dry purification, because only by it can the sulphur be brought to market. On the other hand, the all-lime system is by far the simplest, and perhaps the most reliable. Supplemented by a supply of cheap oxygen, the gas manager who uses it ought to be a happy man. But will he—or, indeed, ought he to—be so, as long as there is a possibility of effecting complete purification without either lime or oxide, or extraneous assistance of any kind, and with the recovery of sulphur in a more valuable form than the familiar one of spent oxide. Such a prospect was opened out, not wholly for the first time, but for the first time in a complete form, by the experiments made a few years ago at the Windsor street gas works of the Birmingham corporation, with the Claus process of ammonia purifying. These experiments have since been repeated on a much larger scale at Belfast; and it is greatly to be hoped that Mr. Stelfox may shortly be in a position to communicate to the members of this Institution the results of his valuable and interesting experience. Whatever these results may prove to be—whether favorable or otherwise—it is hardly probable that the last word will have been said upon a subject of so much economic and scientific importance.

[Concluded from page 890.]

Present Theories Concerning the Nature of Electricity.

By Prof. C. S. Cook.

Prof. Lodge's views on the point just raised are but given in his own words as follows: "Few things in physical science appear to me more certain than what has so long been called electricity is a form, or rather a mode of manifestatis of the ether. Such words as 'electrification' and 'electric' may remain; 'electricity' may gradually have to go. It can be noticed that whereas in the earlier part of the book the word electricity occurs frequently and the word ether seldom, in the latter portion this order of frequency is inverted. A rough and crude statement adapted for popular use is that electricity and ether are identical; but that is not all that has to be said, for there are two opposite kinds of electricity, and there are not two ethers. But there may be two aspects of one ether, just as there are two sides to a sheet of paper, or two aspects of a transparent clock face; and similarly positive and negative electricity may be two aspects, or, as I have sometimes called them by chemical analogy, 'components of the ether.' Anything that can be sheared (and ether is sheared by every electromotive force applied to it) must consist of two parts sufficiently different to be displaced in opposite direction. If this statement is vague, it is because the knowledge of the structure of the ether is vague, not because the relationship

of the electricity to ether is uncertain, or will be anything but definite so soon as we know the constitution of the ether more precisely. Vague at present our knowledge of the ether is, but not so vague as these lines may suggest. That which has now to be investigated is not the nature of electricity, but the nature of the ether, and a question it is indeed; *the* question of the physical world at the present time. But if it is not unanswerable, it is, in my belief, not far from being answered. And it is probably a simpler question than the supplementary and next subsequent question, What is matter? It is simpler, partly because ether is one, while matter is apparently many."

Electricity manifests its presence in four ways. We recognize electricity in charges, in currents, in magnetism, and less familiarly as yet in radiant energy, that is, "radiant heat" and light. Let us see if we can get some notion of the part played by the ether in each of these cases.

Let us note, however, the most significant fact that we are to take a very unfamiliar view of things, and are to greatly change our ideas of the part played by the conducting body. There are indications that we shall be called upon to consider nearly all the activity as residing in the dielectric surrounding the conductors, both in the case of charges and of currents. In this view Faraday has led the way, and we are but extending his ideas. By the dielectric we mean in reality, of course, the ether surrounding the conductor, with its properties somewhat modified by the matter also present. But our attention is to be fixed on the ether.

It is possible to give only the briefest outlines of the theory as detailed by Prof. Lodge. It is impracticable now to give any account of the mechanical analogies which he uses so freely to make his meaning clear. Such a sketch can carry very little of the force which the fuller statement would possess.

To explain electrical charges we are to assume what seems a very artificial and curious condition of things as existing in the ether. It is perhaps the most inconceivable part of the whole scheme, and we are to accept it provisionally as a "working hypothesis." It is that the ether consists of electricity in a state of entanglement similar to that of water in a jelly. The electricity (and the ether, for that matter), it will be remembered, is incompressible; and when an electromotive force acts upon the electricity it produces no compression, but rather a tendency toward displacement resisted by force resulting from its entanglement, just as we know that the water contained in a mass of jelly does not flow out at the bottom or sides, although gravity is constantly urging it downward. This is the condition of things in a dielectric. Conductors are very different in this regard, and are like cavities in the jelly, cavities, however, filled with a more or less porous body which allows the ready passage of a liquid, but with friction.

Some idea of what is involved in charging a body is gained by conceiving that a little of an incompressible liquid is forced into a cavity in a mass of jelly. There will result a strain of the walls of the cavity which will enlarge the space within. When electricity is forced by an electromotive force into a conducting sphere, we can best conceive of what happens by supposing that the dielectric surrounding the sphere is forced back a short distance from the surface, the intervening space being occupied by a volume of electricity equal to that forced into the sphere. We thus have a result in accordance with the well known fact that "charges reside on the surface," and we see that there has been no change in the quantity of electricity in the metallic sphere, *i. e.*, there is no charge there.

Let us next consider how conduction is to be viewed, that is, how electrical currents are conveyed. Here we meet with equally remarkable conceptions which, however, have much to support them, both in mathematical theory and experimental result, particularly in the famous experiments of Hertz.

The familiar and correct idea is that electricity is forced into one end of a wire by some generator, and flows out at the other end into the ground, or to the generator again; we are accustomed to think that the energy is transmitted just as the electricity is. The new theory is that the energy is, on the contrary, propagated through the dielectric surrounding the wire, while the electricity flows in the conductor. It is the function of the generator to produce a strain in the dielectric surrounding it. This strain is not, however, transmitted equally in all directions, but is largely directed by the wire, which it surrounds and accompanies to an indefinite distance. By taking up a portion of this strain and dissipating it as heat, the wire seems to make this indefinite transmission possible, as otherwise there would be a balancing of forces which would produce equilibrium and put an end to this statical effect.

In the transmission of power by electricity we are to conceive that all the energy received by the motor has come from the generator, not through the wire, but through the air, or perhaps better, through the ether which surrounds the wire. That portion of the energy which does get into the wire is the portion which is wasted as heat, and which never reaches the motor. We can get some support for this idea from certain facts proven by Hertz as well as by several others. It was shown that when the currents traversing a wire are made to alternate very rapidly the flow of electricity is confined to the surface, whereas, for ordinary currents, it is well known to traverse the whole wire. If the disturbance in the wire comes from without, inward rapid alternations of impulse from the dielectric would be likely to cause superficial disturbances in the wire, which would not be the case if the alternations be slow or if the strain be continuous, as with a constant current.

Many experiments have been tried to determine if an electrical current does not possess momentum. Surely the ether possesses inertia, and if electricity is the same as ether, or even a component of it, it should show momentum when set in motion. Very familiar facts do show this property. The phenomena of self-induction are best explained in this way. A current requires time to acquire its full power, and the spark seen on breaking a circuit is good evidence that it does not readily stop flowing. However, there are simple mechanical effects which a moving body possessing momentum should show, which have been looked for in vain. Indeed, any of the ordinary mechanical effects of momentum have never been observed. It is evident that a pipe traversed by a rapid stream of water would, when moved, show results of inertia, as well as whenever the water is suddenly started or stopped. Prof. Lodge explains this apparent lack of inertia by saying "that an electric current really consists of two equal flows in contrary directions, so that mechanically they neutralize one another completely, while electrically—*i. e.*, in the phenomena of self induction or extra current—they add their effects. Or it may mean merely that the momentum is too minute to be observed. Or, again, the whole thing—the appearance of inertia in some experiments and the absence of it in others—may have to be explained in some altogether less simple manner, to which we will proceed to lead up," and he later gives an explanation which cannot be reproduced here. All that can be said at present is that there is no experimental evidence that need be taken as disproving the existence of inertia of electricity, while the facts of self-induction are strong evidence in favor of its existence. Furthermore, the well known theories of Ampere, Weber and Maxwell concerning magnetism and dia-magnetism require that an electric current shall persist in its motion until checked by some resistance, in other words, shall possess momentum. We have good grounds, then, for asserting that in all probability electricity possesses inertia.

The flow of electricity is surely opposed by friction. Ohm's law may be interpreted as affirming that the friction between the electricity and the conductor varies directly with the velocity of the former.

In this connection it is of great interest to consider the density and the elasticity of the ether. If ether and electricity should be found to be one and the same agent, then the values to be given for the ether become those of electricity.

We have seen the velocity of transmission of a vibration in an elastic medium is equal to $v\frac{E}{D}$. This law applied to the ether becomes the expression for the velocity of light, but light we know now to be a purely electrical phenomenon; in other words, the only vibration of which the ether is known to be capable is an electrical one. It has been shown by Maxwell that in the formula $V = v\frac{E}{D}$ we may replace the E by $\frac{I}{K}$, that is, that specific induction capacity is directly related to the elasticity of the ether. We may similarly replace the D by π; that is, magnetic permeability corresponds to density of the ether. These are important conceptions. Induction is viewed as a shearing stress, which if strongly resisted signifies small inductive capacity in the dielectric, or considering the ether we say it resists the shearing stress in virtue of its high elasticity. This means that specific inductive capacity varies inversely with the elasticity of ether. Similarly great magnetic permeability is interpreted as implying great ether density. The ether contained in iron is viewed as possessing a high density, much higher than that in any other matter.

Basing his reasoning on what is called a "justifiable assumption," Sir Wm. Thomson finds that the energy in a cubic cm. of ether near the sun is 1.886 ergs, the greatest tangential stress per sq. cm. 30.176 dynes, the density $9.36 \times 10{-}19$, and the coefficient of rigidity 842.8. The elasticity of steel is about 109 times this last figure.

The only theory yet proposed to explain magnetism is the well known Amperian hypothesis that magnetic phenomena are due to the circulation of electric currents around the atoms of the magnet, these atoms being necessarily perfect conductors of electricity. Dia-magnetism is

singularly explained by Weber's hypothesis. A magnetic field is explained by assuming that each line of force is surrounded by a whirl of ether, of which rotation the line of force is the axis.

Of the four methods of manifestation of electricity previously named (charges, currents, magnetism and radiation), the fourth is the most intricate, and in so far the most difficult of explanation. Yet it is by far the best understood, and indeed it may be said in a *general* way to have been completely explained. This remarkable progress has been accounted for by saying that we have very great and peculiar advantages naturally for the study of this class of phenomena through the possession of a sense, that of sight, which directly observes the vibrations in question.

Maxwell's electro magnet theory of light is now established, and constitutes an immense advance in electrical theory. It involves logically the inclusion of all optical phenomena in the domain of electrical science. The laws of refraction of light may now with some propriety be classed with Ohm's law. Both may be said also to deal with electrical velocities.

The experiments of Hertz on electric radiation have become so familiar that it is unnecessary to do more than to allude to them as constituting in their results an immense contribution to electrical theory.

Only one point on this subject will be considered. It is very well known that the discharge of a Leyden jar, or a flash of lightning is in reality a multiple discharge, an almost instantaneous alternating current discharge, a fact discovered by Joseph Henry. The frequency of the alternation of current in the discharge of any charged body is expressed as equal to $\frac{1}{2\pi\sqrt{LS}}$ where L is the self-induction, and S the capacity. With an ordinary Leyden jar discharge there are something like 10,000,000 vibrations per second, with a wave length of radiation of say 20 metres.

If we compute the magnitudes involved in the production of waves as short as those of light say .0006 millimeter, we will have a body of atomic dimensions, which indicates that light vibrations are due to electric discharges of atoms.

In his address as vice-president of the section of physics of the American Association for the Advancement of Science in 1884, Prof. Trowbridge made the following remarks in answer to the question, "What is electricity?" (the title of his address): "We shall probably never know what electricity is, any more than we shall know what energy is. What we shall be able, probably, to discover, is the relationship between electricity, magnetism, light, heat, gravitation and the attracting force which manifests itself in chemical changes. What we are to have in the future is a treatise which will show the mechanical relation of gravitation, of so called chemical attracting force, and electrical attracting force, and the manifestations of what we call radiant energy. Out of all the theories of electricity, the two fluid theories, the one fluid or Franklin theory, and the various molecular theories, not one remains to-day under the guidance of which we are ready to march onward. All that we can truly say is, we have a healthy distrust of our theories, and an abiding faith in the doctrine of the conservation of energy."

Such a view as to the future of electrical theories seems a discouraging one, yet it should not be so considered. We do not know and perhaps never will know what *matter* is, yet the atomic theory is an expression of scientific truth. While we may never know the whole truth as to the nature of electricity, what is sought for, and what will very likely soon be formulated, is a theory which will give us as definite conceptions of electricity and electric phenomena as the atomic theory enables us to have of the nature of matter and its properties.

It is not possible that Prof. Trowbridge foresaw, in 1884, how rapid the progress in solving these problems was to be. In the seven years since he wrote there has been a very remarkable advancement, until now, as Prof. Lodge puts it, "the whole subject is astir with life, and every month seems to bring out some fresh aspect, to develop more clearly some already glimpsed truth."

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, June 10, 1891.

Gas Institute Annual Meeting.—The Distribution of Electricity.—Sulphur in Coal.—A One Burner Gas Cooker.

The event of this month is the meeting of the Gas Institute, at Carlisle, which is now in progress. The preliminary announcements issued to the members from the secretary's office indicate a very satisfactory state of affairs.

There is a goodly list of papers, treating on subjects that are essentially questions of the day, and also a long list of applicants for membership. The annual report sets forth that the Institute is now duly incorporated and goes on to notice the appointment by the Council of a Publication Committee, a Technical Committee, and a General Purposes Committee. Extracts from the reports of the first and last named are included in the report, and also a long list of books presented to the library, together with cash donations for the same object. The idea of a reference library was only mentioned at the last meeting, and the degree of support rendered to it shows that before long the library will be an important feature of the Institute. The whole report presents evidence of that healthy activity which is indispensible to the well being of an institution of this kind.

The report of the Publications Committee sets forth that the library should represent all branches of literature bearing upon gas matters, including complete files of the more important technical periodicals, transactions of societies, patent specifications, etc., together with copies of all standard works. It suggests an annual grant from the funds of the Institute, a donation from every member on his election, presentation copies from authors, and exchanges from other societies. All this is sound and practical and will no doubt be carried into effect. The General Purposes Committee have been considering the labor question, and while of opinion that the varying conditions in various parts entirely preclude the fixing of anything like hard and fast standards, they suggest the full discussion of the question. This suggestion is likely to be carried into effect at the present meeting, as the programme includes a paper on "Gas Workers' Strikes, with Suggestions for their Prevention," by Mr. Nickson, the Secretary of the Manchester Corporation Gas Works. As this gentleman will be able to speak from experience, an interesting paper may be expected. Surely it is possible to adjust labor differences in a friendly way, but the labor agitators evidently think not. Just now London is suffering the inconvenience of a general strike of omnibus men, and I notice that the leaders of the agitation make a point of exciting ill feeling against the masters, representing that they are tyrants from whom no advantage can be obtained except by force, and talking largely about what the men will compel the masters to do. This is just the line of policy they have followed in the gas workers' and other strikes, which in the end have to come down to a question of friendly arbitration and discussion. Whatever Mr. Nickson may have to suggest on this important question, he will probably agree that class feelings and prejudices must "be struck out," and that those who foster them on either side are responsible for increasing the difficulties of satisfactory settlement. A free and friendly discussion between all parties concerned—and this rarely includes either the trade union or the trade agitator—is the direction in which to look for a solution of this difficult problem.

The only important drawback to the success of the meeting is the remarkable prevalence of influenza during the last few weeks, and this in almost every part of the country. In some towns it has caused the death rate to go up three and four fold, assuming the proportions of a veritable plague. So that where members had escaped it so far as their own persons are concerned, they have it in their families or amongst the employees at the works. At one time nearly 10 per cent. of the members of our House of Commons were laid aside by its ravages, and in the case of some 400 delegates of a friendly society being summoned to a convention in this city from different parts of the country, a still larger proportion were absent from the same cause.

Some years ago, when the introduction of electricity for lighting purposes was just talked about, it was said that the cause of the high price as compared with that of gas was simply the small scale on which it was worked. Reference was made to the high cost of gas in villages and small towns, and by inference it was assumed that, given a sufficiently large scale of working, the electric light could be supplied as cheaply as gas in our largest towns. Increased experience shows that this is all a mistake. Several private institutions, factories, etc., in London and elsewhere, having the electric mains of some large company carried past their doors, prefer to put up a private installation and find themselves able to make electricity for themselves at a price much lower than that at which it can be distributed from a central station to earn a fair dividend. The most reasonable explanation of this is the loss in distribution, which must be very much greater than that usual in the case of gas. Possibly on a large district it may be 30, 40, or even 50 per cent., but be that as it may, it seems to be a proved fact that private individuals can provide themselves with electricity generated on the premises at a cost of 8 to 10 cents per board of trade unit, while the electric companies find a charge of 16 cents to be barely remunerative. This fact has led to the suggestion that gas, at the price usually obtaining in our large towns, is the cheapest medium for the distribution of electricity; or, in other words,

that it would be cheaper to generate the electricity in every block by means of gas engines, than to generate it on the large scale and supply it from a central station. Given an efficient set of accumulators, that would contain say 24 hours' supply, so that the engine would be run for from four to eight hours per day, there is no reason why efficiency, combined with economy and reliability, should not be obtained. Talking of supplying electricity on the large scale, we shall soon have an opportunity of judging as to the economy to be thus secured. At the works at Deptford, for the supply of the city of London, it is said that 10,000 horse power dynamos, having armatures 35 feet in diameter, and weighing 225 tons, are being fixed. The field magnets alone will weigh 350 tons. Two 5,000 horse power engines, one at each end, will be attached to the shaft of this machine, and the armature will serve the purpose of a fly wheel. Five such sets of apparatus are to be put down at Deptford, and will be capable of supplying a million lamps. The most sanguine electrician could scarcely wish for a larger plant than this.

The current number of the *Journal of Gas Lighting* contains a very interesting series of experiments on South Yorkshire coals and cannels, showing not only the total quantity of sulphur present in the coal, but how it is disposed of, the proportion that passes off with the gas, remains in the coke, or is retained by the ash. The quantity that passes off at the outlet of the condenser is the chief consideration for a gas engineer, and this is not exactly the same as that which passes off with the volatile products, seeing that a considerable and also a variable proportion is deposited with the tar. As regards the coke, the proportion retained by the ash is of no importance except so far as it represents waste, but that given off during combustion has some effect on the value of the coke, as a sulphurous coke will be objected to. It should be mentioned that the experiments were tried by Mr. Thos. Holgate, engineer to the Halifax Corporation Gas Works. The results are so variable as to show that but little importance can be attached to the proportion of sulphur present in a coal as found by analysis. For instance, a coal containing over four per cent. of sulphur actually allowed less to pass off with the gas than another containing two per cent. In the former case about two-thirds of the sulphur remain in the coke. In several instances the gas was also tested by the referees' apparatus for sulphur compounds, and here again the results were so variable as to render it impossible to draw any general deduction. A coal that yielded only 0.27 per cent. of sulphur in the volatile products, gave nearly as high a result in sulphur compounds as one that showed over one per cent. These results were secured by the medium of an experimental iron retort, and it would be interesting to know how far different circumstances of distillation, such as the temperature, duration, thickness of charge, etc., affected the figures obtained. The whole strongly supports the view I have previously expressed, to the effect that refinement upon the present methods of purification can only be obtained by careful researches conducted at each gas works, rather than by broad generalizations. They also show the importance of actual practical tests, as a means of arriving at the comparative value of samples of coal.

Messrs. Billings & Company, of London, have brought out what they call a one burner gas cooker, in which the whole of the operations usual in the course of preparing a dinner are supplied by a single burner, while some of the advantages peculiar to an open fire are also obtained. The one burner consists of an asbestos fibre gas fire. It is placed in the base of a cast iron case, the upper part of which is occupied by an oven, and the top serves as a hot plate for pans and kettles. A fall down door closes the space in front of the gas fire, and when this is shut up the apparatus is used for heating the oven or hot plate only, with a small consumption of gas. When the door is opened a sort of Dutch oven, large enough to contain a 12 lb. joint, is placed upon it. In this meat can be roasted, pastry can be baked, or toasting, grilling, etc., conducted as before an open fire. Or if the oven is removed, the gas fire is available for warming the apartment, or generally for any of the purposes of an open fire. It is scarcely possible that an apparatus of this sort would compare advantageously in a practical test with gas stoves of the usual kind, but against this there is the gain in profit in simplicity due to doing away with the taps and burners on the ordinary hot plate, and the convenience of being able to use the stove for warming purposes. The inability of the existing gas cookers to meet this want is frequently a bar to their introduction, whereas Messrs. Billings' new make may, if proved satisfactory, be put in as a complete substitute for the wasteful and troublesome kitchen fire.

ABOUT a fortnight ago a slight fire occurred in the condensing room of the Aurora (Ills.) gas works. An overflow of oil is said to have been the cause of the outbreak, which might have been very serious were it not for the promptness of the local fire department.

The Use of Asphaltum in Building Sea Walls.

BY MR. W. C. AMBROSE, C. E.

The Ventura Division of the Southern Pacific Railroad is built for several miles along the bluffs facing the Pacific Ocean. The material of these bluffs is sand and gravel between strata of soft rock soluble in water; and though the violence of the waves is moderated by a group of islands about 22 miles off shore, at high water of spring tides with southwest gales they wash away the bank very rapidly, and protection for the road in some places was soon found necessary. The seashore at the foot of these bluffs is generally covered 2 or 3 feet deep with boulders and sand over the hard bed rock—hence the use of piling was impracticable. The rise and fall of tides, which would interfere very much with the work of building a concrete wall, as well as the high cost of labor, would make such a wall very expensive, so it was decided to try the use of asphaltum for a mortar to hold the boulders together, as a wall made of boulders alone had been easily knocked down by the waves.

At various points near this part of the road there are beds of material known as bituminous rock, and asphaltum. The first contains fixed bitumen, 24.4 per cent., and ash, 75.6 per cent.; the ash consisting of silica, 46.8 per cent., carbonate of lime, 9.1 per cent., oxides of iron and alumina, 15.9 per cent., and other ingredients 3.8 per cent. This material is much used in California in making pavements, and in coating piles to resist the teredo, which it does effectually. In order to liquefy it when heated, coal tar or crude oil must be added. About 200 feet of wall was built with this material, and it has stood perfectly for the last three years and prevented any washing away of the bank. After building this section of wall, the other material, known as asphaltum, was tried because it was cheaper. It liquefies without the addition of any flux, and when cooled it is not quite so hard but more elastic, and on the whole as good a cement as the other. It is often used for lining cisterns, and was used for 800 feet of this wall.

The wall was made 6 feet wide at the bottom (where it was in contact with the bed rock), 2 feet wide on top, and 9 feet high, the landward side, which was built close up against the cliff, being vertical. To economize asphaltum, only one-half the wall, viz.: two feet backward from the seaward face, was cemented. The cost was $3.75 per cubic yard, which included everything except the old piles for fuel, and rail transportation 28 miles for the asphaltum. In building this wall a layer of stones was placed, and the melted asphaltum poured over it so as to thoroughly fill all interstices and run down to adhere to the next layer of asphaltum. In warm weather the asphaltum becomes quite soft, but not liquid, and in this condition has little tensile strength, but the first spray from the waves hardens it just when necessary. The only part of the wall which failed was a short section where, to improve the alignment, it was built a little outside the base of bank, the space between being filled with sand. During a heavy storm, waves dashed over the top of the wall and saturated the sand, and the resulting increase in thrust from behind, pushed the wall over. This of course could have been avoided by making the wall so high that spray could not fly over it, or by increasing the width of base to resist pressure from the land side.

The writer thinks that when asphaltum can be had at a cost less than $10 a ton, this will be found a cheap sea wall. The stones on the beach, which because of their smallness and smoothness are of little or no use for ordinary rip-rap, can by this means be utilized, and are generally to be found in any required quantity on the spot.

Alternating Current Phenomena.

Alternating currents are the El Dorado of the electrician. It is with them that he is able to produce his most startling results, and to discover new phenomena that at first sight appear little short of miraculous. The most successful experimenters in this branch have been M. Hertz, on the Continent, Professor Oliver Lodge, in England, and Professor Thomson, in America. The latter created an immense sensation at the Paris Exhibition by his wonderful experiments in repulsion, which have since been repeated in this country by Dr. Fleming. More recently M. Nikola Tesla, who has taken up the subject, gave in the *Electrical World* an account of what he had done, with some exposition of his views of the theories involved. This led to an animated correspondence between himself and Professor Elihu Thomson, with no very decided results. Since then M. Tesla has shown his experiments in public, at a meeting of the American Institute of Electrical Engineers, held in Professor Dwight's room, Columbia College. There was employed an alternate current machine of 400 poles, which, when run at full speed, gave 20,000 alternations per second. This machine was driven by an

electric motor, the speed of which could be adjusted from the platform by a switch.

M. Tesla commenced his lecture by the question, "What is electricity?" and in answer stated that this much could be assumed—that electric phenomena are ether phenomena; that the phenomena of static electricity are the phenomena of ether under stram, and that those of dynamic electricity and electro-magnetism are the phenomena of ether in motion. Naturally he turned to the question that is occupying the attention of all scientific electricians, the direct production of light by the effect of electro-magnetic waves in the ether. In regard to this he differs from Hertz and Lodge, asserting that the electro-magnetic waves are unavailable for the production of luminous effects for the reason that long before the necessary frequency was reached the conductor would become opaque to the passage of the rays. It is to the electrostatic waves, or thrusts, that M. Tesla looks for the solution of the problem, for these, no matter what their frequency, can excite luminous radiation. The conditions of success require the use of an open circuit generator of high potential and of high frequency to enhance the electrostatic effects, and it was for the purpose of securing these that he constructed the machine used in his researches.

The current from the generator was sent through the primary of an induction coil, and was speeded 10,000 to 11,000 alternations per second. The coil emitted a clear note which rose as the number of alternations was increased. As the discharges took place between the terminals of the coil, an exhausted Geissler tube held in proximity to the discharge did not light, but on blowing out the arc the tube lighted up, which was due to the rise of potential caused by the rupture of the arc. This effect M. Tesla considered purely electrostatic. He then went on to show the changes produced in the discharge, by altering the capacity of the body from which it emanated. He wrapped an insulated wire a foot long around one terminal of the induction coil and touched the other terminal by a brass sphere held in the hand. Streams of light emanated from all sides of the wire until the sphere was removed, when they immediately ceased. As the length of the wire was gradually reduced by cutting off successive pieces, the stream discharges became more marked and brilliant. The substitution of a small platinum wire still further increased the effect. When small spheres, 4 in. in diameter, were attached to each terminal, the spark passed first across the shortest distance, and then gradually ascended to the highest point, when it went out and re commenced below. This was due to the heating of the air between the spheres.

The next experiments were designed to show static effects in a non-striking vacuum. A tube of this kind, when connected to the machine, glowed brightly and the terminals became incandescent. M. Tesla then remarked that if, instead of using a filament in a lamp—which necessarily limits us in the degree of incandescence which we can practically employ—we could employ solid blocks of carbon, much higher efficiency could be obtained. Based upon this reasoning, he has constructed a lamp which he showed, containing two blocks of carbon in non-striking vacuum. By connecting these two carbons to the two terminals of the coil or one to one terminal and the other to a body of some size, the blocks can be raised to high incandescence.

M. Tesla also showed a lamp with but a single rod filament in non-striking vacuum with no outward connection. The energy is entirely transferred by condenser action through the medium of condenser coatings in the base of the lamp. He also pointed out how the brilliancy of the lamp could be varied by simply altering the relative positions of the condenser coatings. This M. Tesla followed by demonstration of the phenomena with an unexhausted globe, and a single filament mounted therein. The filament, when connected to one terminal of the coil, heats up to bright incandescence and spins around in the globe.

In further demonstration of his theory that the electrostatic effects are active, M. Tesla hung two large sheets of zinc to the terminals of the machine at a distance of 15 feet apart. A Geissler tube placed between the sheets glowed brilliantly, and could be moved about freely. Finally, M. Tesla explained a system of conversion from high tension to low, with the enormous frequencies of the condenser discharge. This consists in continuously charging and disruptively discharging a condenser into the working circuit, the charging of the condenser being effected by a coil operated either by alternating or direct currents. He stated that by this means any desired frequency could be obtained from any lower frequency.

The experiments, a part only of which we have noticed, occupied a long time, and were watched with the keenest attention. Whatever we may think of M. Tesla's theories, the very greatest interest attaches to all researches of this kind, as they appear to point in the direction of obtaining artificial light with less expenditure of energy than at present. The miserably low efficiency of all kinds of lighting apparatus at present in use, including electric lamps, is no credit to science, and every avenue that promises better results is being eagerly explored. Of course the end is not in view at present, and all that can be done is to grope in various directions in the hope that some clue may be found that will lead to success. If an electric lamp could be produced having an efficiency of 50 per cent. or more, artificial light would become absurdly cheap.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Arthur E. Boardman, writing from Richmond, Ky., under date of June 19, says: "The Gas and Water Works here were inspected and tested by the City Council and many prominent citizens, on Tuesday, the 16th inst., and were accepted as satisfactory and according to contract. The gas works are what we know as eight inch works, with stage floor retort house and two story purifying house. The holder is an iron tank, has capacity of 27,000 cubic feet and is guided by the Pease wire rope arrangement. This seems to work very satisfactorily and is certainly capable of keeping the holder steady in all sorts of weather. The main, starting from the works and extending to the center of the city, is of 10 inch pipe, and branches in all directions, with smaller sizes as usual. There are 125 street lamps, and the gas, which is very satisfactory to the people, is a very great improvement on the old mixture of oil gas and air formerly in use. Of course it is a coal gas works as a foundation, and at present cannel coal is the enricher. There may be in the future a water gas annex, as the management thinks the mixture pretty good. The water works consists of a reservoir, capable of holding some 50,000,000 gallons of water; a purifying station, with two Worthington duplex compound pumps, each 1½ million gallons capacity and supplied with steam by two return tubular boilers, each of 100-horse power. The main to the city, about 2½ miles, is of 12-inch pipe. The distributing mains run from 12 to 4 inches in diameter, and are about 7 miles in length. The tower is of brick, 70 feet high, with iron tank 36 feet high on top. They are 25 feet in diameter, and give pressure such that a single stream was thrown vertically, at the Court House, 97 feet high, while four streams at once were thrown to a height of over 90 feet. There are 62 hydrants for fire purposes, and more wanted. After the test the Council and some particular friends partook of a glass of wine with the President, and some eloquent speeches were listened to. Having had a recent experience, you can imagine how pleasant these occasions are in Kentucky."

All of which goes to show that Mr. Boardman has faithfully kept his promises made to the Council of Richmond when he and his associates asked the right to establish a gas and water works in this pretty, thriving Kentucky city.

The officers of the Richmond Water and Light Company are: President, Arthur E. Boardman, Brevard, N. C.; Treasurer, Edward H. York, Portland, Me.; Secretary, Chas. S. Powell, Richmond; Superintendent, M. N. Driggars.

We are indebted to a local correspondent for the following, respecting the 33d annual meeting of the Port Hope (Can.) Gas Company. The report of the Directors which was presented by the President, (Mr. J. Smart) was as follows: "In presenting this, the 33d Annual Report and Profit and Loss Account, duly audited, your Directors have much pleasure in being able to state that our year's business shows a slight increase in our sales, and greater returns from our bye-products. Whilst from the introduction of incandescent lighting at the beginning of the year, we looked for a shrinkage in our gas sales, we are now happy to say that, although some of our largest customers have, in part, used the incandescent lamps, such loss has been more than made up by new customers for house lighting and summer fuel, and as we are still much below the average consumption of gas in similar towns in the United States where coal is half the price that it is here, and gas as high or higher, we may yet look for a further increased consumption in that direction, as a gas service once enjoyed for either light or fuel is seldom or ever parted with—for there are no broken chimneys or lamp cleaning, no fuel to carry in or ashes to carry out. A match lights it and the finger regulates the fire to the required heat. Light experts tell us that a Rochester coal oil lamp consumes one gallon of coal oil in 33 hours, and a 3 feet gas burner 100 feet of gas in the same time, each giving equal light. As a gallon of coal oil costs 28 cents, and 100 feet of gas 20 cents, we claim that gas is the cheaper light of the two. Our customers tell us that for summer fuel 3,000 feet of gas, will, if properly used, do as much cooking as a ton of coal, costing the same price, with almost an entire absence of heat in the kitchen, or dirt of any kind, which, of

itself, ought to recommend its use to every lady who values her own health or that of her house help. Our service to the public continues to give entire satisfaction, which is the very best evidence that our officers are discharging their duties efficiently. Our sales to private consumers have increased from 1,800,000 cubic feet to 2,400,000 cubic feet. We have a number of influential shareholders who could, through their influence, materially aid in the extension of our business, and thus help us to earn a reasonable return on their capital. What is required at a $2 net rate is, an output of at least double our present sales, as is evidenced by our dividend of 3 per cent. for 1890, and 4 per cent. for the past year, a rate entirely too low for the risk incurred." President Smart, in moving the adoption of the report, said: "I am happy to say our business of last year has been much more satisfactory in its results than looked for at the beginning of the year. Our sales, instead of decreasing under opposition, have slightly increased, and the higher price of coal tar and the demand for coke have also helped us. Our leakage percentage has also fallen largely, which is an evidence of the better condition of our street service, and the almost entire absence of complaint by our customers establishes the fact that our gas, both in supply and quality, has been entirely satisfactory to them. The replacing of the old shop service of small lead with larger iron pipeage, has very materially assisted in removing the cause of trouble and complaint formerly made by several of our largest consumers." On motion of Messrs. G. M. Furby and J. H. Helm, a vote of thanks to the Board of Directors and other officers for their efficient management during the past year was cordially tendered. At a subsequent meeting of the Directors, Mr. John Smart was unanimously elected President of the Company for the current year.

Mr. William Tracy, Secretary and Superintendent of the Alton (Ills.) Gas and Electric Light Company, writing under date of the 20th inst., says: "Since my return from Louisville I have had my hands full. I have completed putting down the new 8-inch main, and now have but 300 feet or so of 6-inch Converse joint pipe to lay. I have six men running service pipes this week, and have set up 22 large gas stoves, so far, and have orders to put in seven or eight more at once. In the next year or so I am sure my 8-inch main will be none too large for Alton. I shall also make a contract this week for a half-depth regenerative furnace and bench of 5's. Our city will commence paving the streets this year, and we propose to keep the Gas Company right in line with the city's improvements. I will lay 3,100 feet of 4-inch pipe next month, and when this is down it will give us a good annex to our gas plant. I do not expect to start the cold storage or ice making plant this year."

The Northwestern Gas Light and Coke Company, of Evanston, Ills., has just enlarged its works. A portion of the new apparatus comprises four purifiers, 10 feet by 10 feet, center seal, lifting apparatus and cast iron floor, for purifying room. The apparatus was furnished by the Kerr Murray Manufacturing Company, of Fort Wayne, Ind.

The Spokane Falls (Wash.) Gas Light Company is building a new gasholder, rated to store 110,000 cubic feet. The contract for the same has also been secured by the Kerr Murray Company.

Superintendent Boynton, of the Chicopee (Mass.) Gas Company, has been authorized to enter into a contract with the United Gas Improvement Company for the installation of a water gas annex (Lowe improved type) on the premises of the Chicopee Company.

Under the latest bids submitted for the public lighting of Denver, Colorado, the city will be called on to pay the following prices: Arc electric lamps (2,000 candle power), on all night schedule, $12.50 per month; on moonlight schedule, $10 per month; incandescent lamps (32 candle power), $2.16⅔ each per month.

We understand that the authorities of Brooklyn, Ohio—a village 3 miles to the south of Cleveland—have under consideration an application from Isaiah Newcomer, of Cleveland, for the right to construct and operate a gas works in the village. The newcomer agrees to furnish gas at 80 cents per 1,000 cubic feet and to maintain any desired number of public gas lamps at the rate of $16 per post per annum, an all night lighting table to be followed. It is further agreed that at no time shall the cost of gas in the village exceed that charged in the city of Cleveland: that mains will be laid under any street or highway, when the gas to be consumed either on public or private account, along such lines can be shown to equal 10 per cent. of the cost of laying the same; and that electric currents for light and power will be furnished. This application results from the refusal of the West Side Cleveland Gas Company, which now supplies gas to a portion of Brooklyn, to make unwarranted extensions of its mains through districts that would not in 10 years time return one-half per cent. on the money so invested in the way of gas consumption.

Mr. John Mather, General Manager of the Superior Water, Light and Power Company, of West Superior, Wis., writes that the Company will construct a gasholder rated to store 200,000 cubic feet. Constructors of gas works apparatus can communicate directly with Mr. Mather, on the matter noted. The holder is to be completed at the earliest possible date.

At the annual election ot the Exeter (N. H.) Gas Light Company, the following officers were chosen: President, F. H. Odiorne; Treasurer, Austin M. Copp; Clerk, A. F. Cooper; Directors, F. H. Odiorne, Samuel Hatch, A. M. Copp, P. Brown and William Burlingame.

Agent Humphreys, of the Lawrence (Mass.) Gas Company, has good reason to be satisfied over the results of his intelligent efforts in placing before the housewives of that city the values and virtues of gas as a means of assisting them to prepare food for eating, and as an ameliorator of the discomforts of the kitchen in this "terribly hot weather." The women of Lawrence appreciated keenly the ease and rapidity with which Miss Anna Barrows, a graduate of the Boston Cooking School, caused steaks to be done to a turn, by the aid of gas in a gas stove, the operation being performed in the shape of an illustrated lecture on gas cooking, given recently at the city hall, under the auspices of the Lawrence Gas Company.

A decree has been entered, by Judge Horton, in the suit of Nicholas C. Miller against Columbus R. Cummings and others, involving shares in the Chicago Gas Trust. Miller owned 2,842 shares of stock in the Lake Gas Company which he transferred to Cummings on representations that the Chicago Gas Trust would construct and operate the works and pay large dividends. The Court finds that these statements were false and rescinds the sale. The Lake Gas Company was merged into the Consumers' Gas Company, and for Miller's shares, Cummings received 356 first mortgage bonds of the Consumers' Gas Company, of the par value of $1,000 each. Miller has agreed to take these first mortgage bonds in lieu of his shares procured by Cummings. There is due Cummings from Miller $96,335.02, for moneys advanced, $62,608 on a note executed April 4, 1887, and the Union National Bank holds an indebtedness of $62,675 against Miller. On the payment of these amounts the Court decrees that Miller is entitled to the 356 first mortgage bonds of the Consumers' Gas Company.

A. L. Badgley, Chairman of the special committee appointed by the City Council of Butler, Mo., to receive proposals for the establishment in that city of a gas and electric light works, writes us that bids must be handed in to the City Clerk on or before July 16, on which date the competition will close. The proposals are to be made on the following bases: "The city to grant an exclusive franchise for lighting the city by electricity, with 20 or more arc lamps, each of 2,000 candle power, for a term of 10 years, and reserves the right to buy the works at any time after 5 years, at a price to be agreed upon, or fixed by arbitration in the usual way; the franchise to revert to the city without cost, and not to be considered in determining the value of the works. The plant to be owned and operated by the grantee, and to consist of some standard system to be approved by the Mayor and City Council, and of sufficient capacity to furnish 80 arc lights of 2,000 candle power each, and as many more as the city or its inhabitants may call and pay for. The incandescent plant to be of sufficient capacity to supply the demands of the city or its inhabitants. All bids must state the price per lamp per month for the 20 lights furnished the city, and must also state the price for both arc and incandescent lamps. The 20 lamps to be located as directed by the Mayor and City Council, and placed 25 feet high, provided that not more than 7 miles of wire for street lamps will be required in city limits. The city to grant an exclusive right to lay mains and pipes under the streets and alleys and other city property for the gas works for a period of 10 years, with the same reservation as to purchase as of the electric light works. Proposals to state time in which works are to be completed after the franchises are granted. Proposals to state the price per 1,000 cubic feet for gas to the city and private consumers."

Butler is the capital of Bates county, Mo., and is in Mount Pleasant township, at a point 66 miles south of Kansas City and 38 miles northeast of Fort Scott, Kansas. It is the center of abundant and valuable coal deposits, and holds a population of perhaps 5,200.

THE Altoona (Pa.) Gas Company's works are to be rebuilt. The new location is on Fourth street, and it is a most suitable one. The plant will be completed by Dec. 1.

THE main provisions of the agreement between the authorities of Chicago and the Gas Company, respecting the price, etc., at which gas is to be supplied to the city and the residents, are as follows: The city is to pay $1 per 1,000 cubic feet, the citizens to pay at the rate of $1.25 per 1,000, until Jan. 1, 1893, when the rate to the latter is to be reduced to $1.20, and every year thereafter the rate is to be reduced 5 cents per 1,000 until the dollar mark is reached. The Company also agrees to pay into the city treasury annually 3½ per cent. of its gross receipts, with a guarantee that the sum so paid in shall not in any year amount to less than $150,000. The city agrees to dismiss all suits pending against the Company that involve any of its franchises.

IF the people of Hamilton, Ohio, were called upon to again vote on the advisability of establishing a municipal gas plant, it is not likely that they would sanction the scheme.

THE following is the text of the decision of the Massachusetts Board of Gas and Electric Light Commissioners, respecting an application for the right to establish an opposition electric lighting plant at Northampton, Mass., the case having come to them on appeal: In response to an invitation by the city, proposals were made in the early part of the year to do the public lighting on the basis of supplying 90 to 110 arc lamps of 1,200 nominal candle power, for a term of five years, burning from dark to midnight according to the moon schedule, so called, or about 25 nights each month. The appellee (Mr. Hawks), by proposal dated February 19, 1891, offered to supply them at $58.50 each, the firm of J. E. Lambie & Co., of said city, for about the same price, and the appellant (Northampton Electric Light Company) for $70 each. But the offer of the appellee was based on the further express consideration that he should receive, according to his understanding of it, a valid and perpetual franchise to use the streets of the city for the erection of poles and stringing wires for the supply of electric lights to private customers as well as to the city. And such, it is evident from the broad language of the vote above quoted, the city intended to give. A contract, bearing date April 17, 1891, the day of the hearing, was executed by the appellee and the city, acting through its committee, in substantial conformity with his offer, the lights to be supplied within six weeks "after the acceptance of said contract by said city government." Although the committee by the vote put in evidence was authorized to contract with a "Company," it will be assumed that the city would accept the contract should further action be deemed necessary. For the purpose of considering the wisdom and legality of the grant to the appellee, the evidence in the case should be carefully examined. To persons familiar with the history of electric lighting the difference in price between the bids of the appellant and the appellee would seem a low estimate of the value for all purposes, commercial and speculative, of such a franchise. The appellee testified that he should retain an interest in the plant during the five years, but would not operate it personally, as he would continue in his present business; that other parties were to own it with him and furnish capital. The names or residence of the parties, though earnestly requested, he declined to give. He stated that he expected to supply both arc and incandescent lights to private consumers, and that without the right to do so he would be unwilling to accept the contract for the public lighting. There are reasons, some of which have been stated by the Board in a former case, why the permission to the appellee is unwise. Admitting, what is extremely doubtful, that the statutes ever intended that an individual should be given the right to occupy the streets for the purpose of doing a general lighting business, he certainly ought not to transfer his license. The permission is personal to him. Such rights should be held and exercised by persons whose names and residence are known, so that they can readily be found if need be. The names should appear in the grant. The real persons in interest, the actual owners, should be declared, as they are the ones who are and ought to be held responsible for negligence or misfeasance. Once admit that the right is assignable by sale, levy, devise or inheritance, it may then pass into the possession of persons wholly unreliable and unfit to perform the duties pertaining to it. Permanent grants of such a nature are best vested in some corporate, continuing body. It is difficult to consider the accepted proposal apart from the purchase of the franchise, but it may be due the parties and the public to examine the case in its general bearings. As appeared by the evidence, the plant of the appellant company is not only sufficient for its present work, city and commercial, but is capable of supplying 1,000 additional incandescent lights and 25 more arc lights. It was not seriously alleged at the hearing that its equipment was faulty, that its price for incandescent light was too high, that its management had been extravagant, or its dividends excessive. The appellee proposes to erect and equip a new plant adequate for all the street lighting and for the commercial lighting so far as he may obtain it, using water power, and charging private consumers the same price as the city for arc lights. It did not appear that his price for incandescent light would be less than that paid to the appellant. While it is true that electrical apparatus can be bought more cheaply now than in 1886, it is believed that a plant capable of doing the street and commercial lighting would cost considerably above the estimate of the appellee. Although he had made no contract therefor, the appellee testified that he could obtain water supplemented with steam for a term of five years at the rate of $25 per horse power a year. Even on this basis the estimate of operating expenses submitted to the Board by the appellee assures no adequate profit on the street lighting, omitting as it does, real estate or rent of premises, insurance, cost of superintendence, taxes, and other expenses, and some of the items included being much smaller than are found in actual practice. There being so many resident stockholders of the electric lighting company it is evident that the appellee would at best get but a share of the incandescent business. There would then be two plants, each doing a portion of the lighting and neither yielding its owners a fair, if any profit. The saving of $5,000 or $6,000 in the expenses of the city during the five years, while a considerable sum, is of little importance when compared with the waste and loss which must follow the unnecessary duplication of plants and a profitless contest for that period. It is a just principle, clearly acknowledged in the recent statute authorizing municipal lighting, that capital wisely expended for the purpose of supplying the public needs, is entitled to be protected against destructive competition, even by a municipality. The rights and interests of the city, the stockholders, and the citizens ought to be considered together, and the consumers in the end are thereby the gainers. The history of electric lighting in Northampton shown by the evidence is instructive. About five years ago there were two rival electric plants in operation in that city. After a few months of sharp competition, low prices and no profits, some of the stockholders of the appellent company, at their own expense, and presumably to give value to their stock, bought and removed the other plant. A like result would probably follow a similar experiment. The Board believes that the legislature intended by the recent acts that all the reasonable and permanent advantages of competition are to be gained through the regulating powers thereby conferred upon it. The statutes assume that cities and towns, as well as private citizens, are entitled to light at reasonable prices. The only avowed object in granting the franchise appealed from was to secure a reduction in rates. The Mayor alone, or 20 customers, if the price is thought too high, may bring petition before the Board, asking that the price may be reduced. This remedy ought to be invoked, if the existing company has suitable equipment, and is well managed, before the community is subjected to the danger and inconvenience of a second system of poles and wires. Any lack of apparatus, or waste in the methods of business, any unnecessary cost of power, indeed, everything relating to the economy and quality of the work of a company, are rightfully taken into account in fixing the price. If it is clearly made to appear that by different manipulation or by the use of other kinds of power, machinery or materials, a considerable saving can be effected, and that these improvements might be adopted by a new company, it would compel the inquiry whether the present one might not fairly be expected to acquire them, or submit to prices based on their possession. In reviewing the facts in this case the Board can discover no just ground for establishing another plant in the city at the present time. The Board therefore sustains the appeal and revokes the permission granted by the Mayor and Aldermen.

The Market for Gas Securities.

The dull summer season is "on" with a vengeance, and quotations in gas shares are infrequent. Consolidated is at 93¼ to 94, and Equitable and Mutual are together at 118 to 120. It is now a pretty well settled fact that Mr. Frederic Egner is to take charge of the engineer's department of the Standard Gas Company, and this of itself ought to be worth many dollars to the shareholders, whose property will now be developed with prudence and certainty. In Brooklyn shares no very great change is noted, but the feeling over there is undeniably that of uneasiness. We note sales at auction of 38 shares Consolidated, New York, at 93¼; 110 shares Williamsburgh, Brooklyn, at 110; and 375 shares Fulton-Municipal, at 115¾ to 116¼. Chicago gas is at 53¼, and Bay State, 56 bid; Laclede, 14 to 16.

JOURNAL OF MANUFACTURE AT WEST STATION.

DAYS OF THE		WEATHER.					GAS MADE.						COMMERCIAL GAS MADE.										STATION METERS.					
		Temperature.			Bar'r.	Condition.	Coal Gas.			Water Gas.			Coal Gas Used.			Crude Water Gas Used.			Total, 24 Hrs.	Per Cent.		Temperatures.			No. 1.		No. 2.		WATER GAS METER.	
Week.	Mo.	7 a.m.	12 m.	7 p.m.	7 a.m.	7p. m.	Day.	Night.	Total.	Day.	Night.	Total.	Day.	Night	Total.	Day.	Night	Total.		Coal Gas.	Wa'er Gas.	Coal Gas.	Wa'er Gas.	Sta. Meter	7 a.m.	7 p.m.	7 a.m.	7 p.m.	7 a.m.	7 p.m.
	1 to 31																											

COMMON COAL ACCOUNT.

Coal on hand .....1st. .... tons. .... " .... " .... " .... " — tons.

Coal received in..... .... tons. .... " .... " .... " .... " .... tons.

Coal carbonized in..... .... tons. .... " .... " .... " .... " .... tons.

Coal in store .....1st .... tons. .... " .... " .... " .... " .... tons.

ENRICHING COAL ACCOUNT.

On hand.....1st .... tons. .... " .... " .... " .... " .... tons.

Received in..... .... tons. .... " .... " .... " .... " .... tons.

Carbonized in..... .... tons. .... " .... " .... " .... " .... tons.

In store.....1st .... tons. .... " .... " .... " .... " .... tons.

FOR MONTH OF.....189....

CONTENTS OF HOLDERS AT 7 A.M. EACH DAY.						COMMERCIAL GAS SENT OUT.			PRODUCTIONS.									MATERIAL USED (Per Ct., Lbs., Bu., Gals., etc.)									QUANTITIES OF MATERIALS USED.								
									Coal Gas					Water Gas.				Coal Gas.				Water Gas.					Coal Gas.				Water Gas.			
No. 6.	No. 8.	No. 9.	No. 10	No. 12	Total.	Day.	Night	Total 24 Hours.	Per Lb. Coal.	Per Ton Coal.	Per Reto't	Per Man.	Per Bu. Coke	Per Lb. Coal.	Per Ton Coal.	Per Bu. Coke	Per Man.	Per Run.	Pr.Ct. Coke. Furnaces	Pr.Ct. Cannel.	Lbs. Cannel per M	Lbs Com in Coal per M.	Bu. Coke per M	Lbs. Coal per M	Bu. Coke per M	Gals. Oil per M	Gals. Water in Boiler	Gals. Water Cond'ns's	Gals. Water per M	Common Coal, Lbs.	Cannel. Lbs.	Lime. Bu.	Breeze in Purifiers.	Lehigh Coal. Lbs.	Coke. Bu.	Oil. Gallis.	Lime. Bu.	Water. Gallis.
31 ruled lines																																				

REMARKS. [Eight ruled lines whole length of sheet.]

PHOTOMETRICAL OBSERVATIONS.				RETORT ACCOUNT.								WATER GAS APPARATUS. RUNS MADE.					PURIFIERS.									MEN EMPLOYED.													
																				Recharged with								Coal Gas.							Water Gas.				
Water Gas.	Coal Gas.	Commercial Gas.	Specific Gravity.	Benches Fired.	Retorts under Fire	Retorts Charged.	Retorts being Decarb'niz'd	Time Out Use.	Charges Made.	Weight of Charges.	Time Run.	No. 1 Set.	No. 2 Set.	No. 3 Set.	No. 4 Set.	Total Runs.	Box Changed.	Cause.	No. of Tiers.	Thickness.	Lime.	Oxide.	Breeze.	Time Run.	Gas Pass'd.	Purified per Bu.	Engineers.	Boiler Men	Charging Men.	Furnace Men.	Barrow Men.	Coal Men.	Total.	Engineers.	Boiler Men	GasMakers	Helpers.	Coal Men.	Ash Men.	Mechanics.	Others.	Total on Water Gas	Total in Works.
31 ruled lines.																																								

COMMON COAL ACCOUNT.

Coal on hand.....1st. .... tons. .... " .... " .... " .... " .... tons.

Coal received in..... .... tons. .... " .... " .... " .... " .... tons.

Coal carbonized in..... .... tons. .... " .... " .... " .... " .... tons.

Coal in store.....1st .... tons. .... " .... " .... " .... " .... tons.

ENRICHING COAL ACCOUNT.

On hand.....1st. .... tons. .... " .... " .... " .... " .... tons.

Received in..... .... tons. .... " .... " .... " .... " .... tons.

Carbonized in..... .... tons. .... " .... " .... " .... " .... tons.

In store.....1st .... tons. .... " .... " .... " .... " .... tons.

COMMON COAL ACCOUNT.						CANNEL COAL.		LEHIGH COAL.		LIMA OIL.		COKE ACCOUNT.									LIME ACCOUNT.		COAL TAR ACCOUNT.		OIL TAR ACCOUNT.		AM. LIQ. ACCT.	REMARKS.
Received.			Carbonized.																								
Tons.	Tons.	Total Tons.	Tons.	Tons.	Total Tons.	Received.	Carboniz'd	Received.	Used.	Received.	Used.	Made.	Used under Reto'ts	Used under Boilers	Under Boil'rs, W.Gas.	Used in Generat'rs.	Used Hoist'g Coal.	Sundry Purposes.	Sold.	Breeze Purifiers.	Received.	Used.	Made.	Sold.	Made.	Sold.	Sold.	
31 ruled lines.																											

REMARKS. [Eight ruled lines whole length of sheet.]

SEDALIA GAS LIGHT COMPANY.

Report for Month Ending....., 18..

CASH STATEMENT.

Receipts.			*Disbursements.*		
From Private consumers			For coal on track		
Delinquent consumers			Hauling coal to works		
Public street lamps			Freight on coal		
Coke sales			Hauling coke		
Tar sales			Water		
Meter security fund			Lime		
Material sold			Tar Barrels		
Meters			Oil		
Services			Paint		
Gas stoves			Fire clay and brick		
Rent of lamps			Clay		
House rent			Lumber		
Gas pipe			Meters		
Gas fittings			Gas fixtures		
Gas fixtures			Gas stoves		
Fire brick and clay			Tools		
			Gas pipe and fittings		
			Machinery and tools repairs		
			Buildings and works repairs		
			Retorts and benches repairs		
			Public lamp repairs		
			Street main repairs		
			Stationery		
			Newspapers		
			Postage		
			Printing		
			Advertising		
			Telegrams		
			Exchange		
			Rent		
			Office furniture		
			Meter security fund return'd		
			Horseshoeing		
			Wagon repairs		
			Harness repairs		
			Feed		
			Insurance		
			Taxes		
			Freight (other than coal)		
			Traveling expenses		
			Hauling		
			Services		
			Construction		
			Lighting public lamps		
			Secretary		
			Superintendent		
			Stokers		
			Labor		
			Labor fitting		
			Expense		
			Drafts to President		
Total receipts			Total disbursements		
Cash on hand at last report			Cash on hand this day— (In bank, $....; in office, $....)		

SEDALIA GAS LIGHT COMPANY.

Report for Month Ending....., 18..

GAS BILLS REPORT.

Gross amount of bills		Cash received	
		Discounts	
		Delinquents	

COST OF GAS.

Expended for		*Realized from*		
Gas coal.....tons, at $		Tar sold.....barrels, at		
Coal and coke under boiler		Coke sold.....tons, at		
Coal and coke under retorts		Rent		
Lime.....bush., at....cts				
Tar barrels.....at....cts				
Oil				
Taxes				
Insurance				
Freight				
Team account				
Tools				
Machinery and tools repairs				
Building and works repairs				
Retorts and benches repairs		SUMMARY.		
Meter and free service repairs				
Public lamps repairs		Expended in making & sell'g gas		
Lighting public lamps		Realized from residuals		
Street mains repairs				
Printing, advertis'g and station'y		Net cost of.....cubic feet of gas sold		
Rent				
Paint				
Secretary		Being at the rate of $..... per 1,000 cubic feet.		
Superintendent				
Stokers				
Labor (excluding fitting work)		*Yield per Pound Coal Carbonized.*		
Lumber				
Clay				
Fire clay and bricks				

FITTING REPORT.

Received.		*Paid Out.*	
For Gas fitting		For Gas pipe	
Gas pipe		Gas fittings	
Gas fittings		Gas fitting tools	
Gas fixtures		Repairs of fitting tools	
Labor		Fitting material	
		Freight	
		Hauling	
		Gas fixtures	
		Labor	

SEDALIA GAS LIGHT COMPANY.

Report for Month Ending..... .....*, 18..*

GAS COAL REPORT.

	Tons.	Pounds.	Tons.	Pounds.
On hand at last report				
Received from				
Received from				
Total on hand and received				
Carbonized				
Used under boilers				
Used in retort furnaces				
Used for				
Total coal consumed				
On hand				

COKE REPORT.

	Tons.	Pounds.	Tons.	Pounds.
On hand at last report				
Made since				
Total on hand and made since				
Sold during month				
Used under boilers				
Used in retort furnaces				
Used for				
Total sold and consumed				
On hand				

GAS REPORT.

	Cubic Feet.	Cubic Feet.	
Station meter registers to-day			
Station meter regist'd last month			
Made during month			
In holder at last report			
To be accounted for			
Gas sold, per c'sumers' meter b'k			
Used in public street lamps			
Total gas sold			
Used at office and works			
On hand, in holder			
Leakage & condensat'n (p.ct.)			
Accounted for			

METER AND LAMP REPORT.

		3 Lights.	5 Lights.	10 Lights.	20 Lights.	Li'hts
Meters in use at last report						
Meters returned during month						
Set during month						
In use						
On hand						
Hours public lamps were lit						
Number of public lamps						

SEDALIA GAS LIGHT COMPANY.

Report for Month Ending..... .....*, 18..*

UNCOLLECTED ACCOUNTS.

		Accounts owing by Company to following parties for following purposes, viz.:		
Unpaid coke bills				
Unpaid gas bills				
Unpaid tar bills				
Unpaid fitting bills				
Other unpaid bills, viz.:				

MAINS, PIPE, FITTINGS, AND FIXTURES.

	On Hand	Used During Month.		On Hand	Used During Month.
Inch mains, feet			Lights, chandelier		
" " "			" "		
" " "			" "		
" " "			Brackets		
" " "			Burners		
" " "			Tips		
Gas pipe			Number of lamps		
Fittings, pounds			Number of gas stoves		
Number of street lanterns			Lead, lbs		

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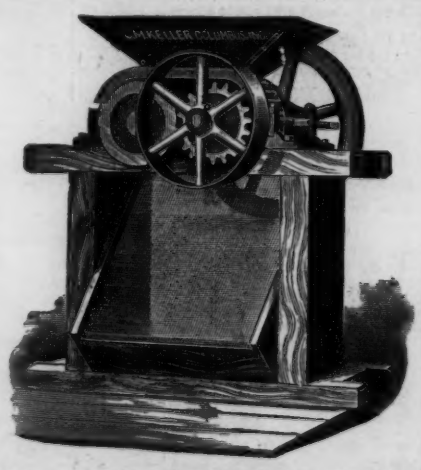

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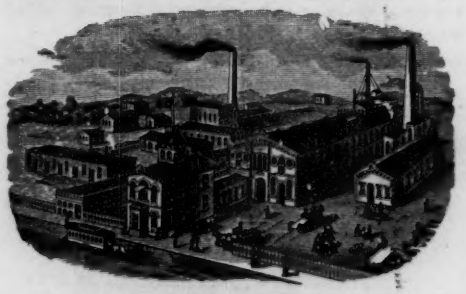

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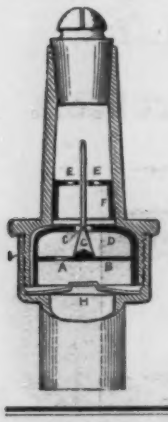

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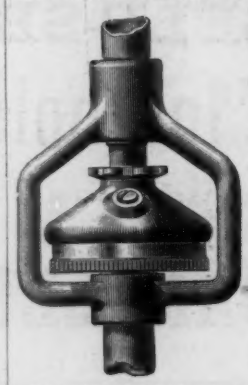

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EVERY CONCEIVABLE SIZE AND STYLE.

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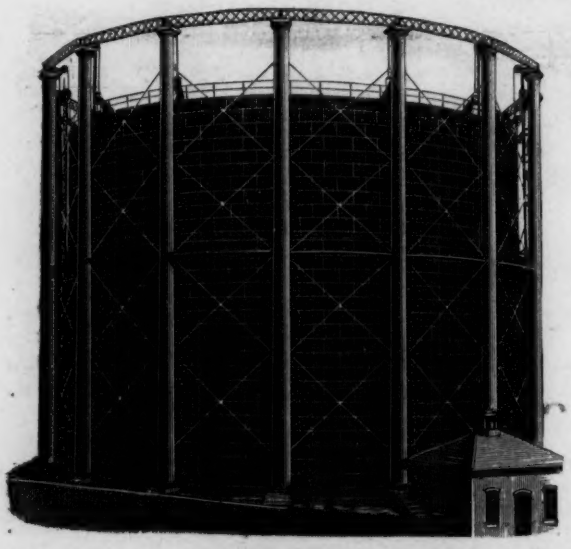

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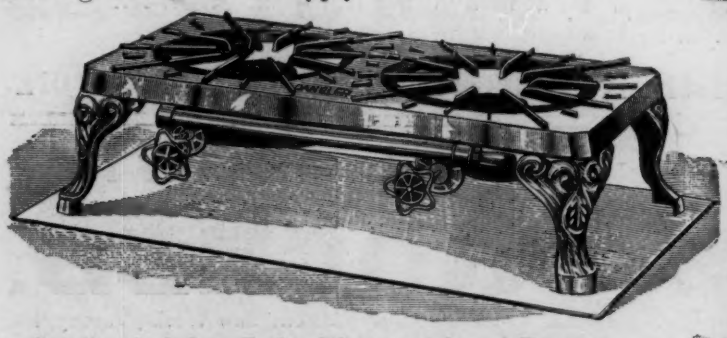

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September 4, 1890.

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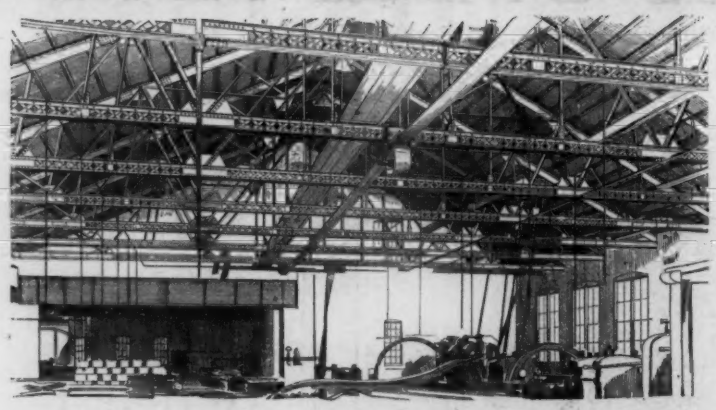

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Extracts the Whole of the Ammonia and a Large Percentage of the Sulphureted Hydrogen and Carbonic Acid.

MINIMUM WEIGHT IN MOTION • MINIMUM DRIVING POWER • MINIMUM BACK PRESSURE • MINIMUM WEAR AND TEAR • WITH MAXIMUM RESULTS.

The "New" Washer-Scrubber, with Wooden "Bundles," has been for many months in successful operation at the London Gas Light and Coke Company's station at Beckton, and at many other European Gas Works
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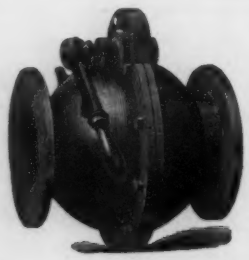

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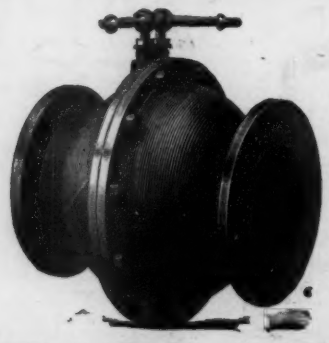

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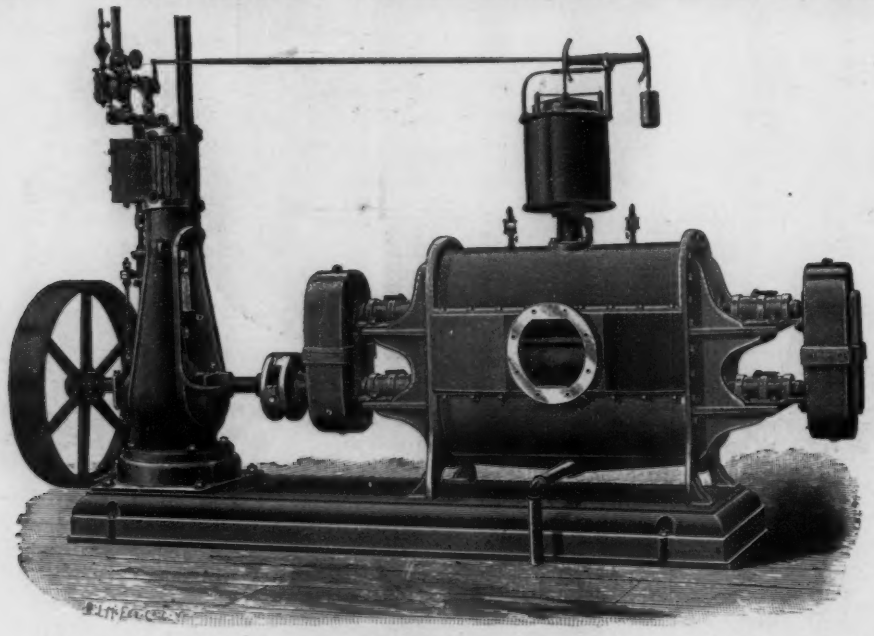

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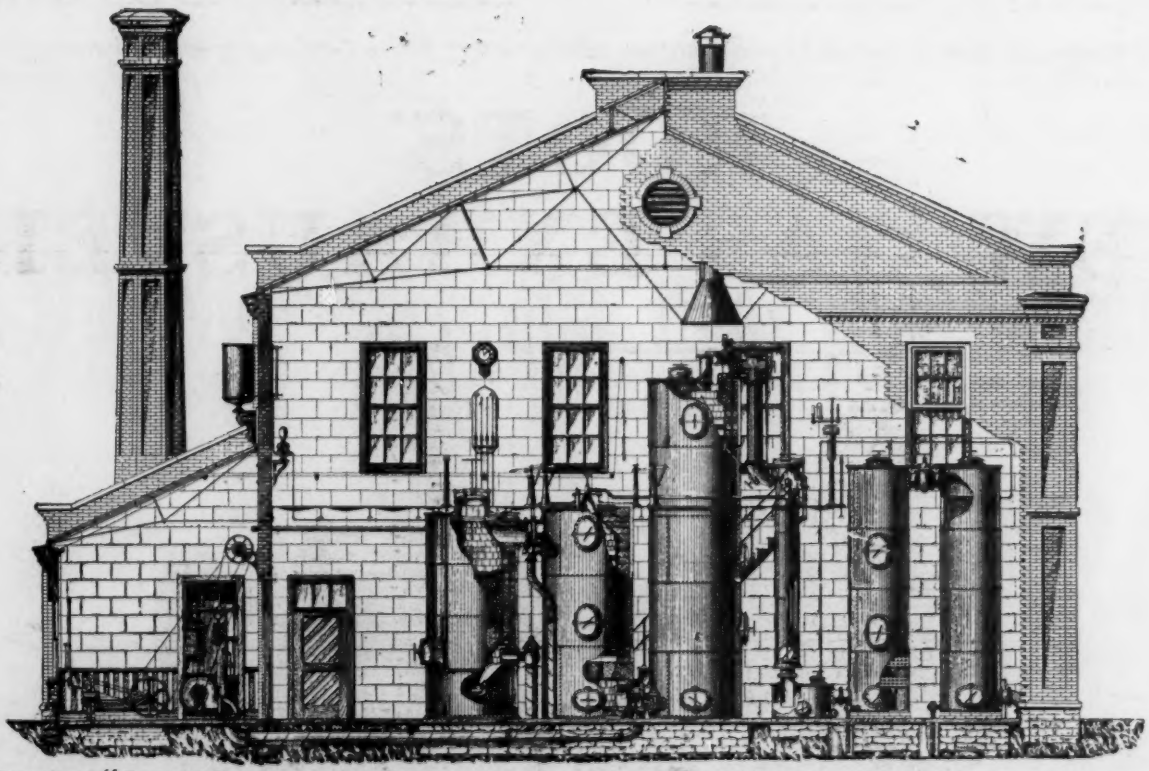

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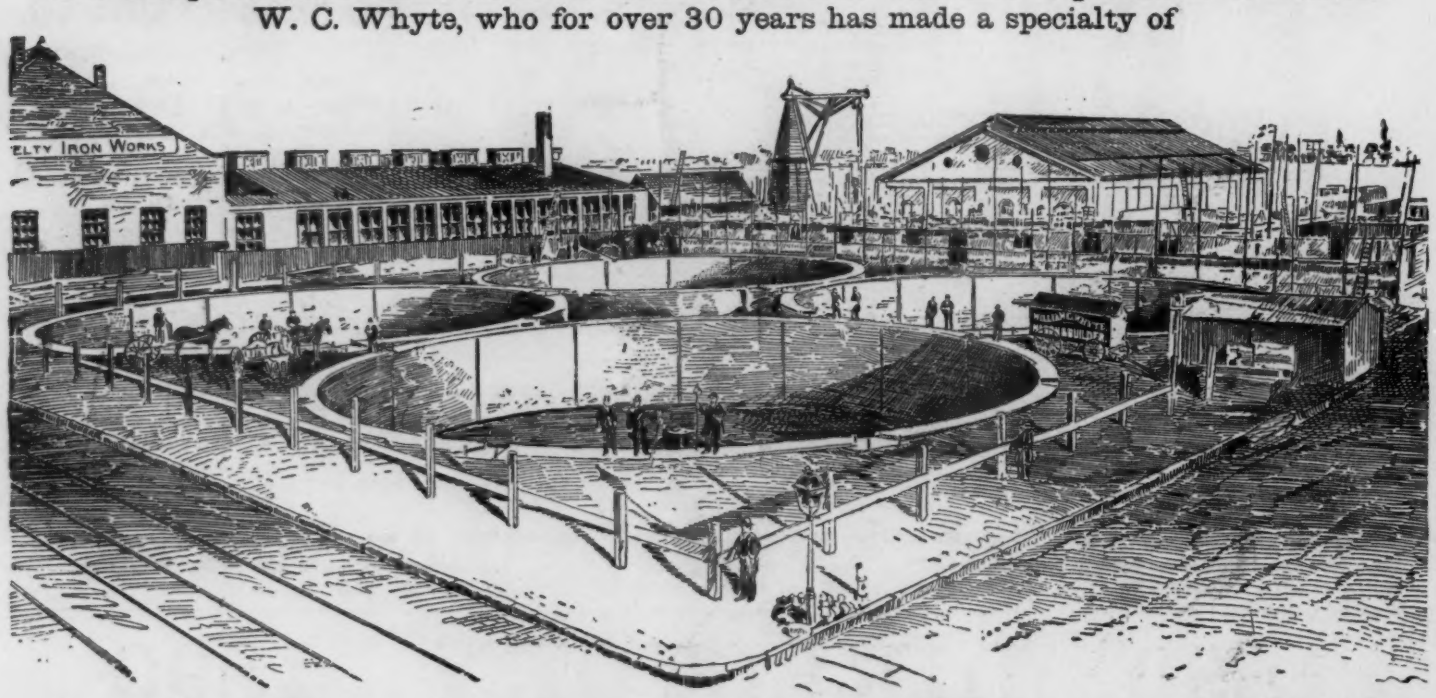

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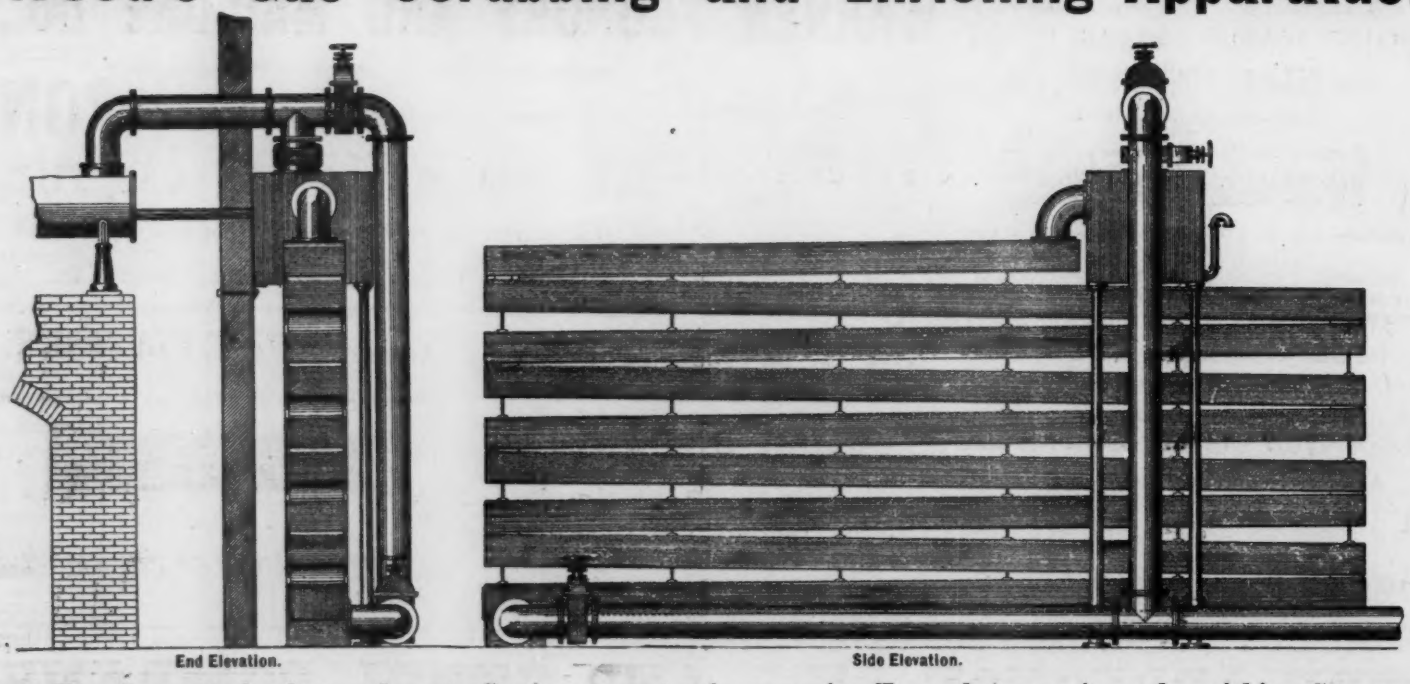

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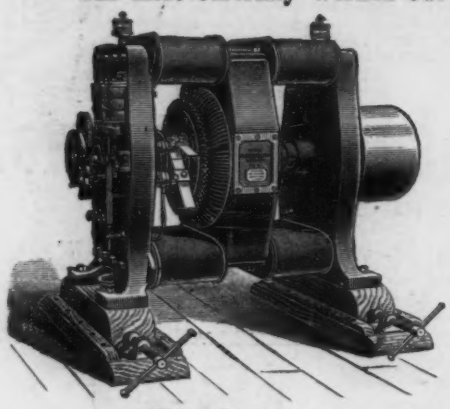

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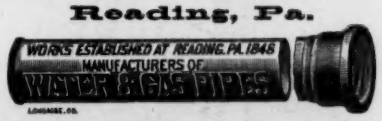

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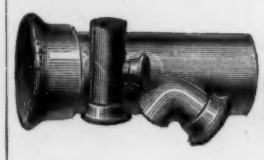

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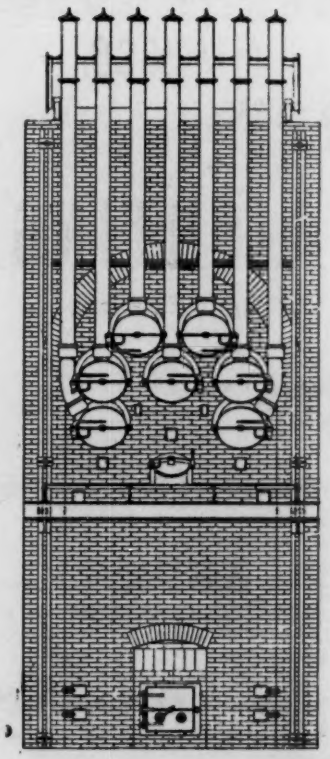

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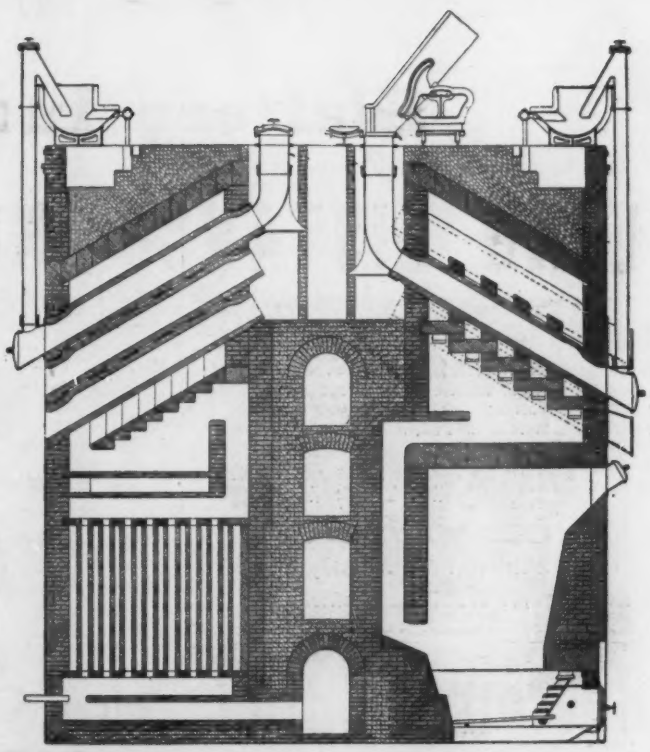

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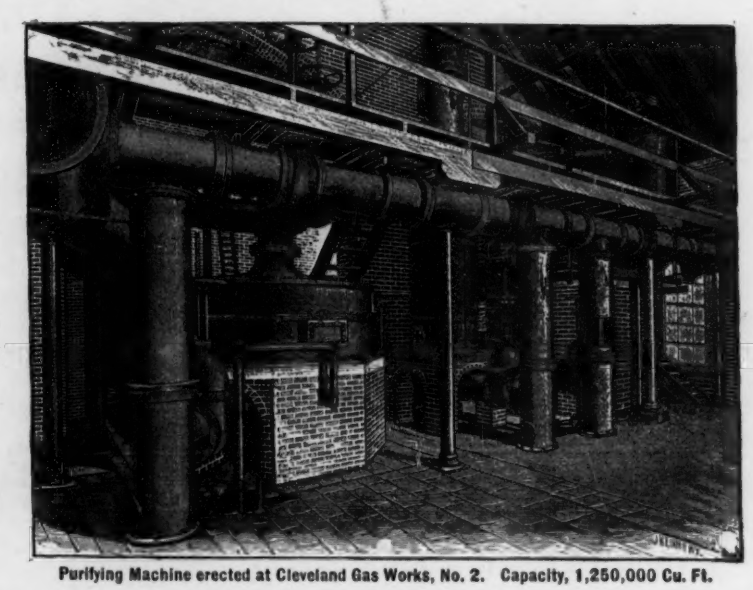

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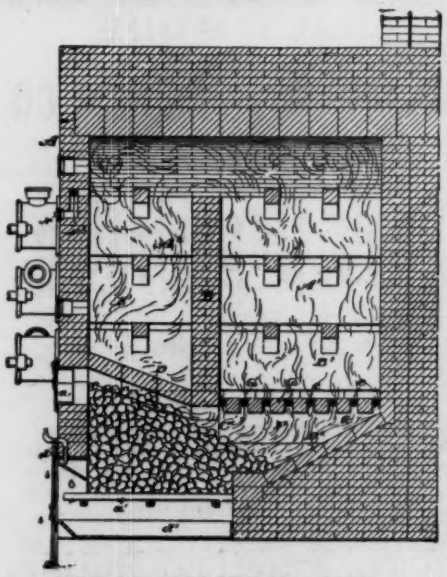

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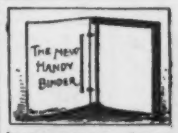

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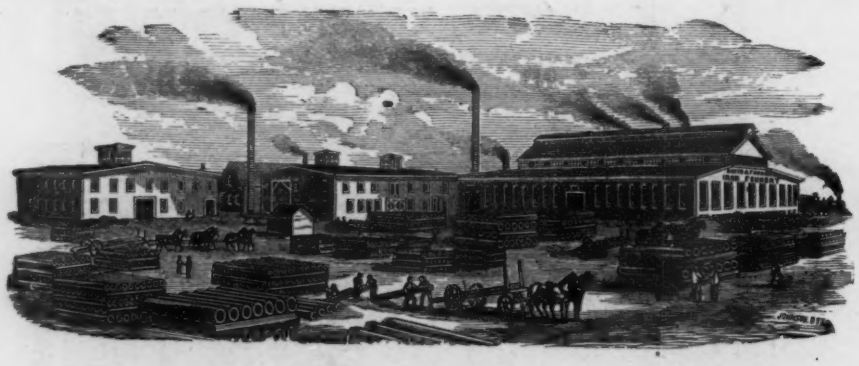

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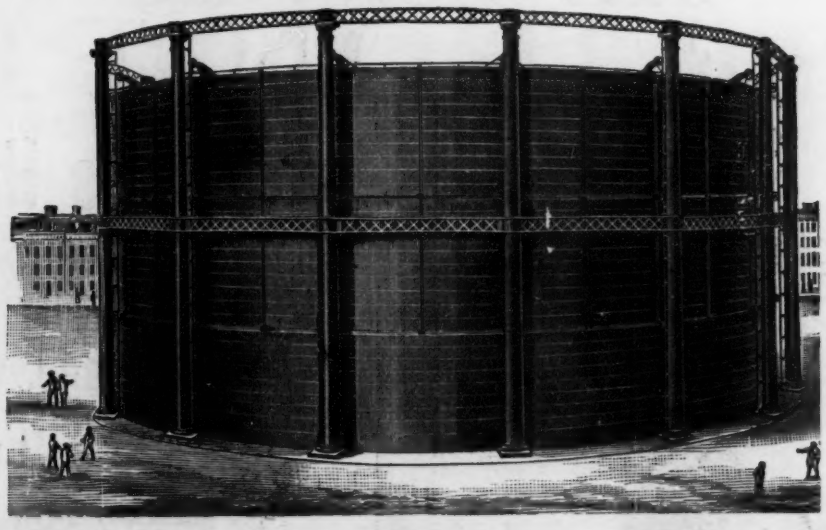

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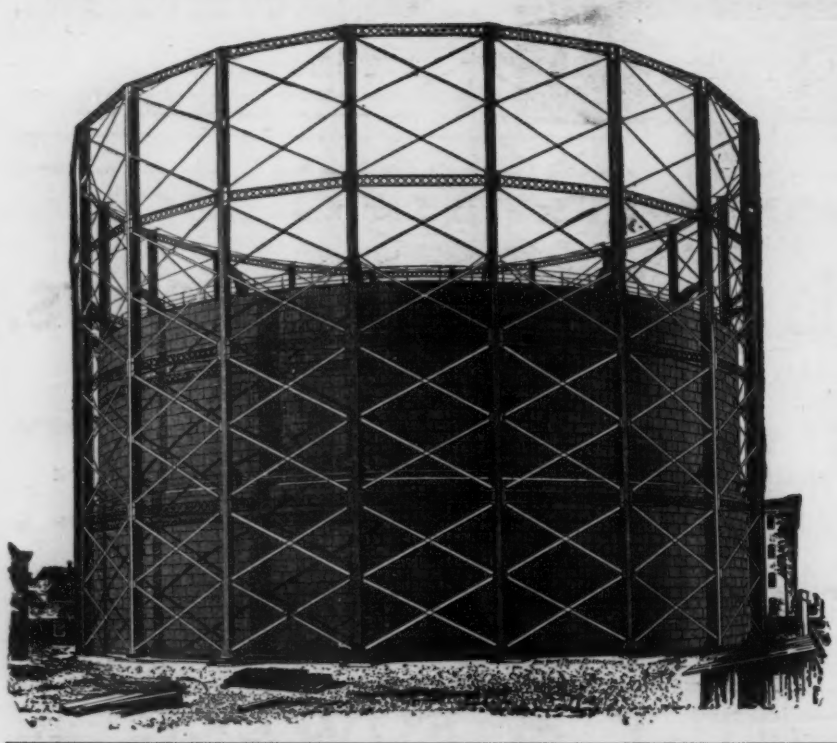

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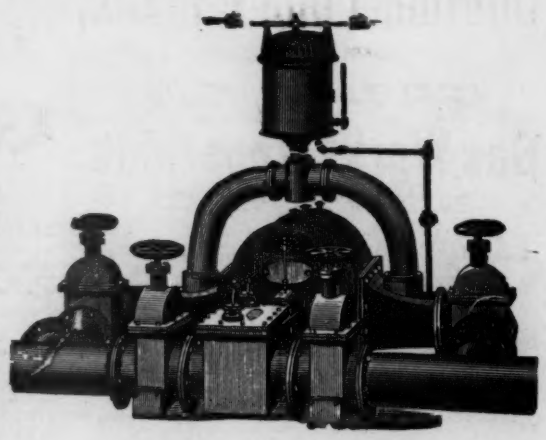

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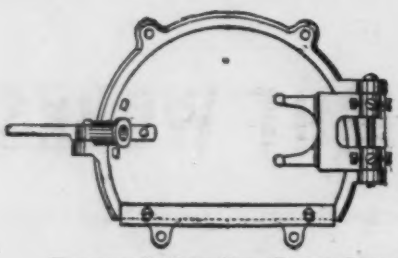

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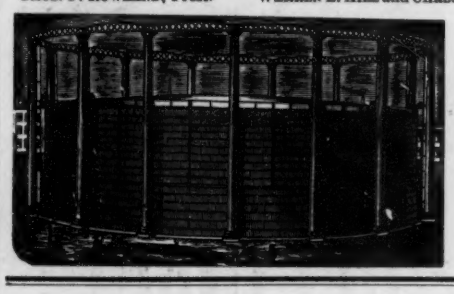

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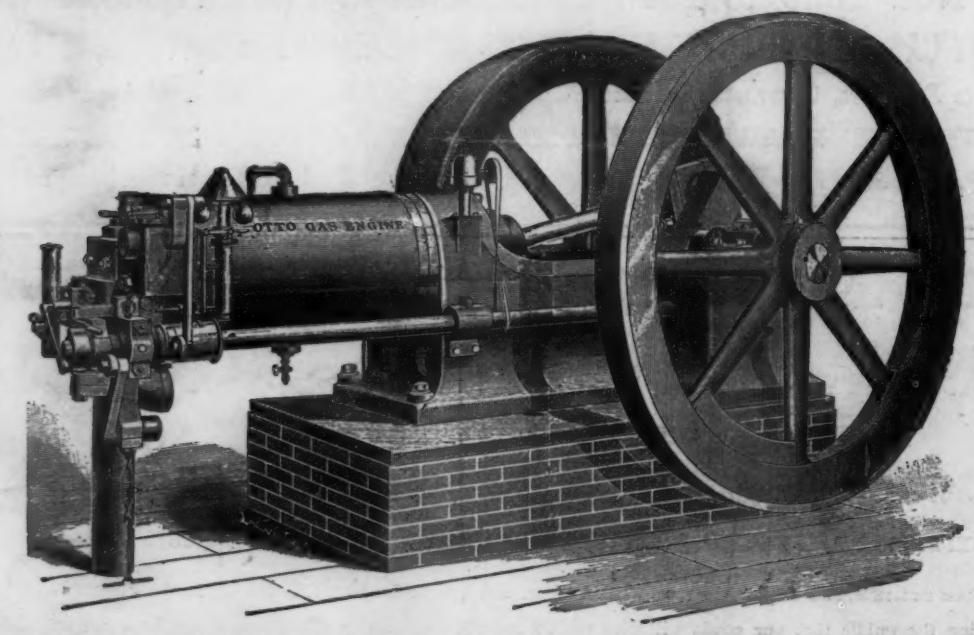

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